Exhibit 7

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,
Petitioner,

v.

COREPHOTONICS, LTD.
Patent Owner

IPR2018-01348
U.S. Patent No. 9,185,291

PETITION FOR *INTER PARTES* REVIEW
UNDER 35 U.S.C. § 312 AND 37 C.F.R. § 42.104

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July 13, 2018

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APPL-1013	Richard Szeliski, Computer Vision: Algorithms and Applications, 2011 ("Szeliski")
APPL-1014	Japanese Patent Application Pub. No. JP2013106289 to Konno et al. ("Konno Japanese")
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I. MANDATORY NOTICES

A. Real Party-in-Interest

The real party-in-interest is Apple Inc.

B. Related Matters

As of the filing date of this Petition and to the best knowledge of the Petitioner, the '291 Patent has been asserted in *Corephotonics, Ltd. v. Apple Inc.*, Case No. 5-17-cv-06457 (N.D. Cal. filed Nov. 6, 2017).

C. Lead and Back-up Counsel and Service Information

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Please address all correspondence to lead and back-up counsel. Petitioner consents to electronic service.

II. GROUNDS FOR STANDING

Pursuant to 37 C.F.R. § 42.104(a), Petitioner certifies that the '291 Patent is available for *inter partes* review and that Petitioner is not barred or estopped from requesting an *inter partes* review challenging the patent claims on the ground identified in this Petition.

III. OVERVIEW OF THE '291 PATENT

A. Summary of the '291 Patent

The '291 Patent is titled "Dual Aperture Zoom Digital Camera" and issued November 10, 2015. APPL-1001, Title. The '291 Patent is directed to a "dual-aperture zoom digital camera operable in both still and video modes." APPL-1001, Abstract.

The '291 Patent acknowledges that use of "**multi-aperture** imaging systems to approximate the effect of a zoom lens **are known**." APPL-1001, 1:49-50; APPL-1004, ¶27. However, the '291 Patent alleges that none of the known art references "provide a thin (e.g., fitting in a cell-phone) dual-aperture zoom digital camera with fixed focal length lenses, the camera configured to operate in both still mode and video mode to provide still and video images, wherein the camera configuration uses partial or full fusion to provide a fused image in still mode and does not use any fusion to provide a continuous, smooth zoom in video mode." APPL-1001, 3:7-13; APPL-1004, ¶28.

As an alleged solution, the'291 Patent describes a dual-aperture digital camera including "a Wide Sub-camera and a Tele Sub-camera" and can "be operated in both still and video modes." APPL-1001, 3:22-35; APPL-1004, ¶29. "In still mode, zoom is achieved 'with fusion' (full or partial), by fusing W and T images, with the resulting fused image including always information from both W and T images." APPL-1001, 3:36-38; APPL-1004, ¶29. "In video mode, optical zoom is achieved 'without fusion,' by switching between the W and T images to shorten computational time requirements, thus enabling high video rate." APPL-1001, 3:42-44; APPL-1004, ¶29.

FIG. 1A below illustrates a dual-aperture zoom imaging system 100 including Wide and Tele imaging sections, each having a respective lens, image sensor, and ISP. APPL-1004, ¶30. FIG. 2 illustrates through exemplary images, a larger FOV for the Wide image provided by Wide sensor 202 and a smaller FOV for the corresponding Tele image provided by Tele sensor 110. APPL-1004, ¶¶30-31.

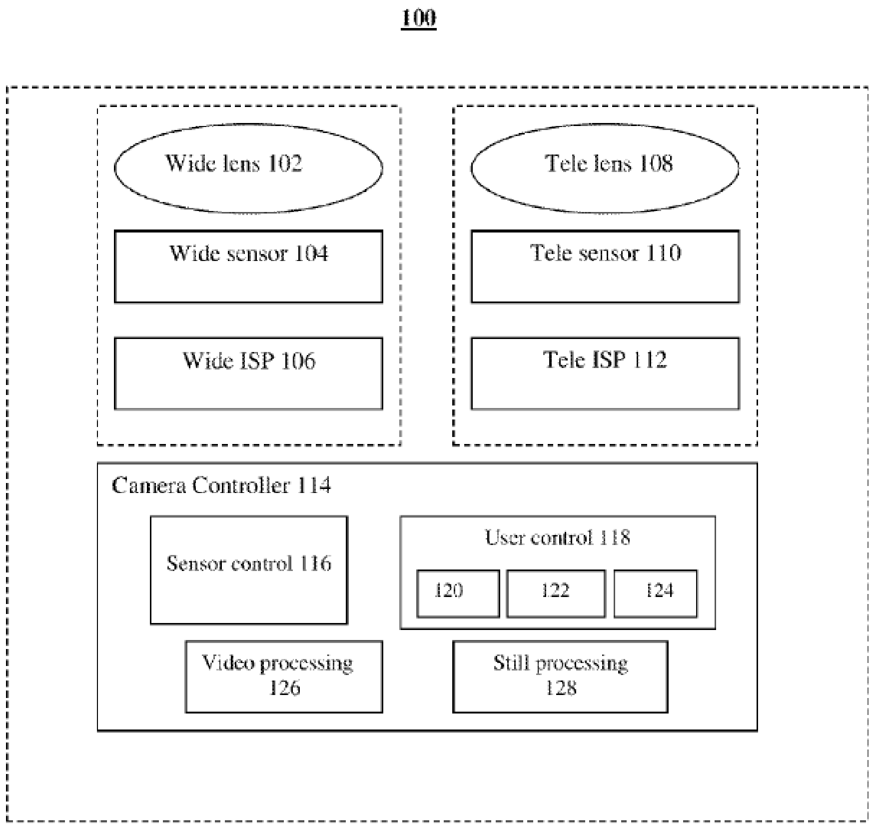

FIG. 1A

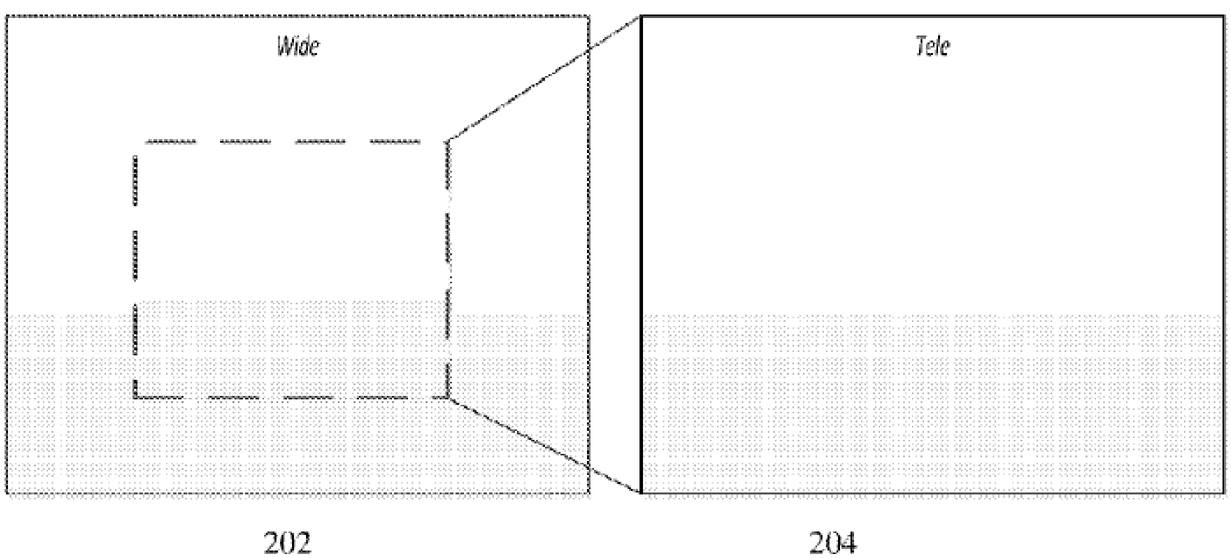

FIG. 2

APPL-1001, FIGS. 1A and 2

However, as demonstrated below, and confirmed by Dr. Cossairt (APPL-1004), it was well-known, before the effective filing date of the ’291 Patent, to provide a zoom digital camera using 1) Wide and Tele imaging sections to provide two images, and 2) a camera controller to provide, in still mode, a fused output image by combining the two images and, to provide, in video mode, continuous zoom output images without fusion. APPL-1004; APPL-1004, ¶¶32-33.

B. Prosecution History of the ’291 Patent

The ’291 Patent issued from Application 14/365711 (“’711 App”), which was the National Phase of PCT application PCT/IB2014/062180 filed June 12, 2014, which claims priority from Provisional Application 61/834,486 (“’486 App”), filed June 13, 2013. APPL-1002, 17; APPL-1003; APPL-1004, ¶¶34-39.

The prosecution history is short. On September 25, 2015, Examiner issued a first action Allowance with Examiner amendment to claim 21 to correct typographical errors. APPL-1002, 382-388; APPL-1004, ¶36. Stated of reasons for allowance were that the prior art did not teach or fairly suggest limitations of part (c) of claim 1 regarding a camera controller and part (b) of claim 12 regarding configuring the camera controller. APPL-1002, 388-389; APPL-1004, ¶36.

On September 29, 2015, the Applicant filed a post-allowance amendment to correct “minor and obvious dependency errors in claims 7, 8, and 9.” APPL-1002, 437-443; APPL-1004, ¶37. The ’291 Patent issued November 10, 2015.

VI. LEVEL OF ORDINARY SKILL IN THE ART

The level of ordinary skill in the art may be reflected by the prior art of record. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001). Here, a Person of Ordinary Skill in the Art ("POSITA") at the time of the claimed invention would have a bachelor's or the equivalent degree in computer science or electrical and/or computer engineering or a related field and 2-3 years of experience in imaging systems including optics design and imaging processing. APPL-1004, ¶19. A person with less formal education but more experience, or more formal education but less experience, could have also met the relevant standard for a POSITA. *Id.* However, Petitioner does not imply that a person having an extraordinary level of skill should be regarded as a POSITA.

V. CLAIM CONSTRUCTION

This Petition presents claim analysis in a manner consistent with plain and ordinary meaning in light of the specification. *See* 37 C.F.R. §42.100(b). Claim terms are given their ordinary and accustomed meaning as would be understood by a person of ordinary skill in the art in the context of the entire disclosure. *In re Translogic Tech., Inc.,* 504 F.3d 1249, 1257 (Fed. Cir. 2007) (citing *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc)). For terms not addressed below, Petitioner submits that no specific construction is necessary for this

proceeding.[1]

A. "a fused output image" (claims 1 and 12)

In the context of the '291 Patent, a POSITA would have understood the scope of the term "*a fused output image*" to at least include "an output image including information from two images." APPL-1004, ¶¶40-44.

The specification of the '291 Patent supports the proposed construction. APPL-1004, ¶42. The specification describes in prior art, Wide and Tele sensors that provide Wide and Tele images respectively, and "[those Wide and Tele] images are then **stitched (fused) together** to form a **composite ('fused')** image." APPL-1001, 2:3-16; APPL-1004, ¶42. The specification provides that in its digital camera operating in still mode, "zoom is achieved 'with fusion' (full or partial), by fusing W and T images, with the resulting fused image **including always information from both** W and T images." APPL-1001, 3:34-38; APPL-1004, ¶42. As contrasted with "fused image," the specification provides that in its digital camera operating in video mode, "optical zoom is achieved '**without** fusion,' by **switching** between the W and T images to shorten computational time requirements." APPL-1001, 3:42-43; APPL-1004, ¶42.

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[1] Petitioner does not concede that any term not construed herein meets the statutory requirements of 35 U.S.C. § 112.

The construction is consistent with surrounding claim language, which provides a camera controller configured "to **combine** in still mode **at least some** of the Wide and Tele image data to provide a fused output image." APPL-1001, 13:10-12, 14:8-10; APPL-1004, ¶43.

Accordingly, in the context of the '291 Patent, a POSITA would have understood the scope of the term "*a fused output image*" to at least include "an output image including information from two images." APPL-1004, ¶44.

VI. REQUESTED RELIEF

Petitioner requests that the Board institute *inter partes* review of claims 1-7, 10, and 12-13 of the '291 Patent and cancel each such claim as unpatentable.

VII. IDENTIFICATION OF HOW CLAIMS ARE UNPATENTABLE

A. Challenged Claims

Claims 1-7, 10, and 12-13 of the '291 Patent are challenged in this petition.

B. Statutory Grounds

Grounds	Claims	Basis
Ground 1	1-5, 10, and 12-13	Obvious under post-AIA 35 U.S.C. §103 over Patent 7,859,588 to Parulski, et al. ("**Parulski**") in view of Published Application 2014/0362274 to Christie et al. ("**Christie**"), and Published Application 2012/0026366 to Golan et al. ("**Golan**")
Ground 2	6-7	Obvious under §103 over **Parulski** in view of **Christie**, **Golan**, and JP Patent App. Pub. JP2013-106289 to Konno et al. ("**Konno**")

Parulski was published September 11, 2008, and issued December 28, 2010. **Golan** was published February 2, 2012. **Konno** was published May 30, 2013. **Parulski**, **Golan**, and **Konno** are prior art to the '291 Patent under at least post-AIA 35 U.S.C. §102(a)(1),[2] and not subject to an exception under §102(b)(1).

Christie was filed May 29, 2014, claims priority to Provisional Application 61/832,958 ("Christie Provisional"), and published December 11, 2014. Christie is prior art to the '291 Patent under at least §102(a)(2), and not subject to an exception under §102(b)(2).

C. Discretionary Denial is Not Warranted

The Board's discretionary determination of whether to institute review is guided by 35 U.S.C. §325(d) and its precedent under §314(a). Under the present circumstances, the Board should not exercise discretion to deny institution.

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[2] The Leahy-Smith America Invents Act ("AIA"), Pub. L. No. 112, amended 35 U.S.C. § 102 to its current, post-AIA version. AIA § 3(b). The post-AIA version became effective on March 16, 2013 and applies to any patent issuing from an application that contains (or ever contained) "a claim to a claimed invention that has an effective filing date that is on or after [that date]." AIA §§ 3(n), 3(n)(1)(B). As the '291 Patent issued on an application that contains a claim claiming a priority date after March 16, 2013, citations herein are to the post-AIA version.

Although Golan was listed in a notice of references cited during prosecution, (APPL-1002, 396), it was never substantively discussed, and thus *inter partes* review in light of Golan-based grounds is appropriate. APPL-1002. *See Limelight Networks, Inc. v. Mass. Inst. of Tech.*, IPR2017-00249, Paper 9, at 7 (May 18, 2017) (instituting despite §325(d) challenge where reference was never substantively discussed by Examiner). Furthermore, Golan is combined as a secondary reference with Parulski, Christie, and Konno, none of which were considered during prosecution. Thus, Petitioner's specific grounds, based on proposed combinations of Parulski, Christie, Golan, and Konno, have not been considered by the Office. Additionally, Petitioner's expert provides evidence as to how a POSITA would understand the teachings of Golan, which has not been considered by the Office. In short, institution is warranted based on Petitioner's challenges, and §325(d) does not provide basis for discretionary denial.

D. Page Citations and Emphasis

For exhibits that include suitable page, column, or paragraph numbers in their original publication, Petitioner's citations are to those original page, column, or paragraph numbers and not to the page numbers added for compliance with 37 CFR 42.63(d)(2)(ii). Also, the following analysis may bold or italicize quotations and add color or colored arrow annotations to the figures from these exhibits for the sake of emphasis.

VIII. IDENTIFICATION OF HOW CLAIMS ARE UNPATENTABLE

A. Ground 1: Claims 1-5, 10, and 12-13 are unpatentable under §103 over Parulski, Christie, and Golan

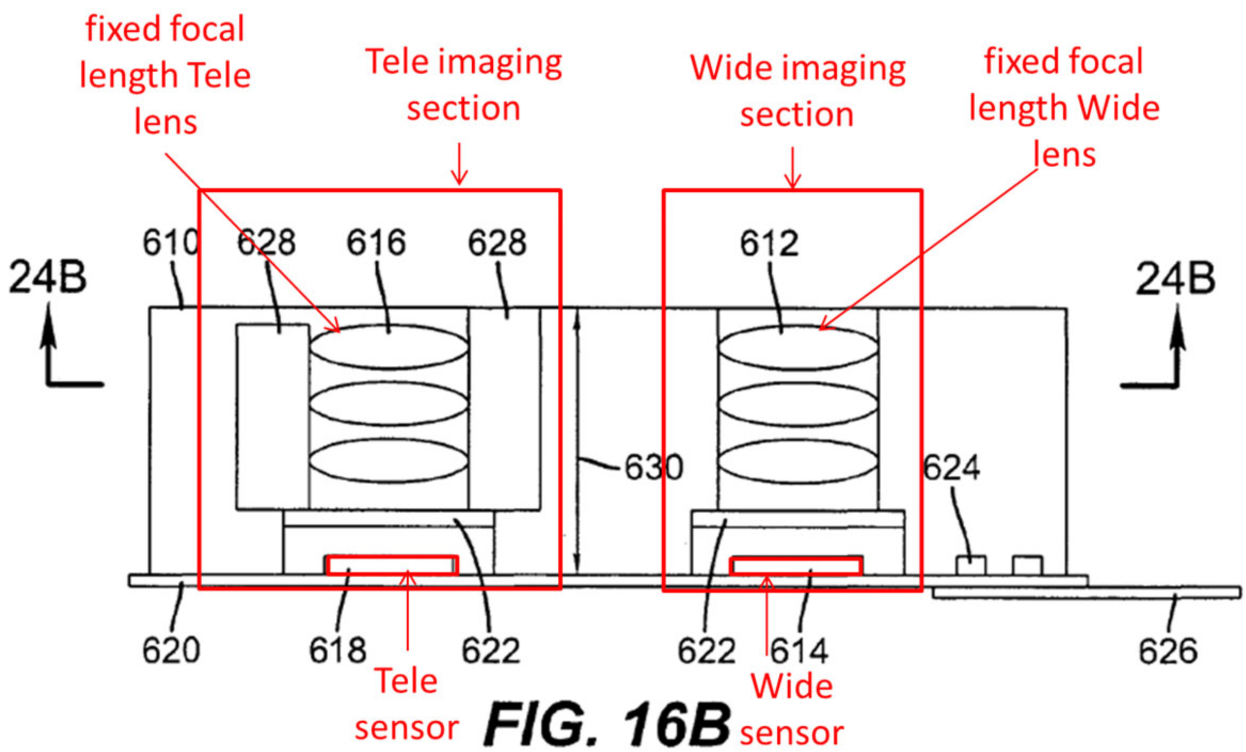
1. Summary of Parulski

Parulski is titled "Method and Apparatus for Operating a Dual Lens Camera to Augment an Image." APPL-1006, Title. Parulski discloses "a digital camera that uses multiple lenses and image sensors to provide an improved imaging capability," where "digital zooming between the wide angle and the telephoto focal lengths" is used to provide an extended zoom range. APPL-1006, 1:8-10, 23:54-58; APPL-1004, ¶45.

Parulski teaches that its dual lens image capture assembly has still and video modes to produce "still images and motion video images," and that zoom still and video images may involve digital zoom based on user input zoom factor. APPL-1006, 12:36-41, 29:8-11, 23:54-61; APPL-1004, ¶¶46-47.

Parulski describes that its "digital camera with dual capture systems ... utiliz[es] both images to provide an improved output image." APPL-1006, 7:21-24; APPL-1004, ¶48. Although Parulski does not explicitly describe its improved output image as a "fused output image," Parulski describes an image augmentation process that "utilizes one of the images from a dual-lens camera as a secondary image that can be used to modify the other, primary image and thereby generate an enhanced primary image." APPL-1006, 7:32-35; APPL-1004, ¶48. As shown relative to annotated FIG.

16B below, Parulski goes on to describe its technique using images from fixed focal length wide-angle and telephoto lenses and image sensors. APPL-1006, 23:28-43; APPL-1004, ¶¶48-50. Parulski describes that a secondary image having a different exposure "may be **combined** with the primary image to obtain an **extended dynamic range** primary image." APPL-1006, FIGS. 14, 26, 7:62-66, 28:58-29:7, 29:20-44; APPL-1004, ¶49. As described herein, such a combined image constitutes "a fused output image," as claimed.



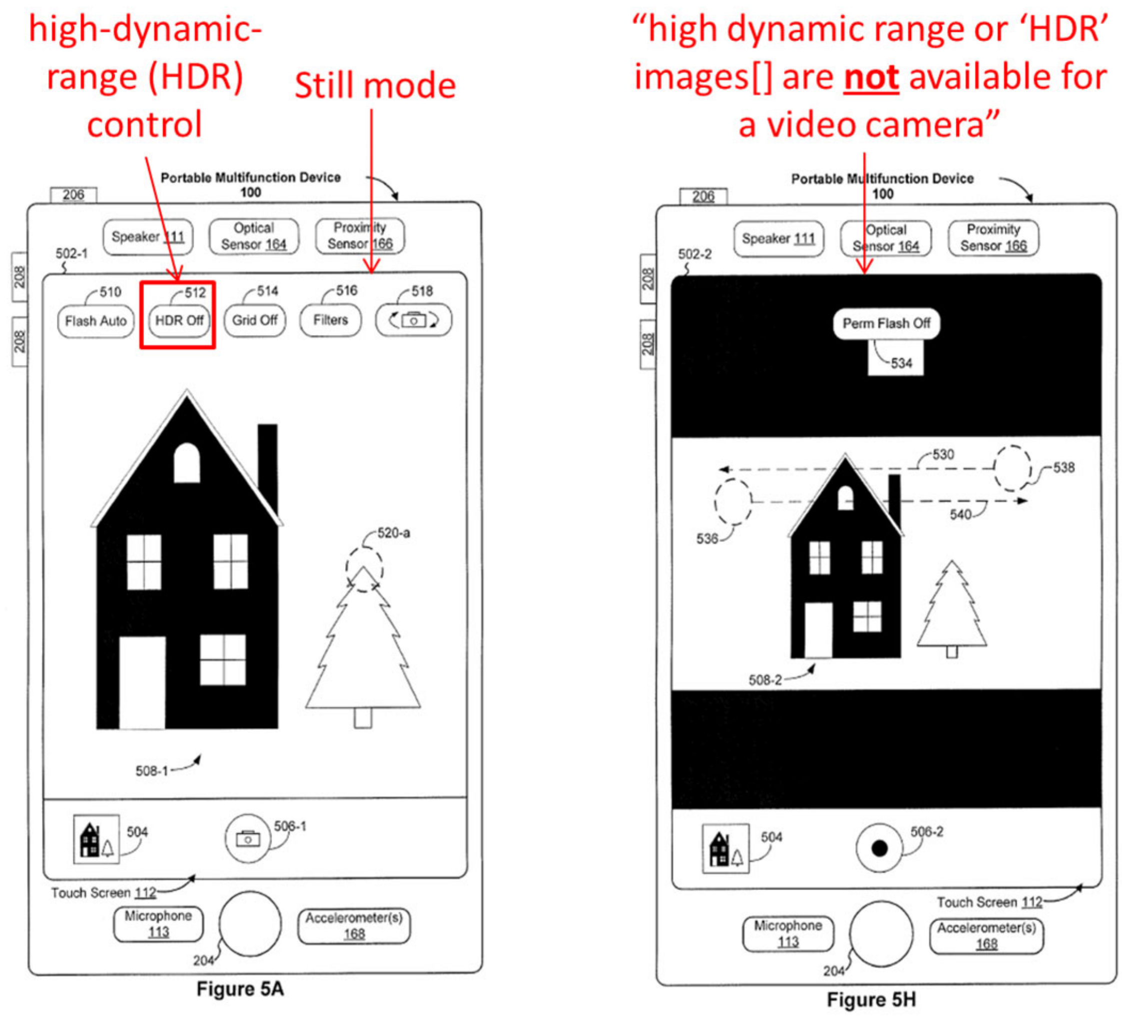
APPL-1006, FIG. 16B, annotated

2. Summary of Christie

Christie is titled "Device, Method, and Graphical User Interface for Switching between Camera Interfaces," and lists Apple Inc. as assignee. APPL-1007, Title;

APPL-1008, Title; APPL-1004, ¶51.

Like Parulski, Christie envisions use of dynamic range improvements based on information from multiple images (i.e., fusion). *See* APPL-1004, ¶52. However, Christie's use of high dynamic range (HDR) is limited to still images. *Id.* Specifically, as shown in FIGS. 5A and 5H below illustrating still mode camera interface 502-1 and video mode camera interface 502-2 respectively, Christie teaches that "**still** image capture options such as **high dynamic range or 'HDR'** images ... are **<u>not</u>** available for a **video** camera." APPL-1007, [0202]; APPL-1008, FIGS. 5A, 5H, [0162]; APPL-1004, ¶52.



APPL-1007, FIGS. 5A and 5H, annotated

Thus, Christie teaches fusion for still images and "without fusion" for video. Further, Christie teaches "faster, more efficient methods and interfaces" using "finger contacts and gestures on the touch-sensitive surface," and the motivation to "conserve power and increase the time between battery charges" for battery-operated devices. APPL-1007, [0005]-[0006]; APPL-1008, [0004]-[0005]; *see* APPL-1004, ¶53.

a. Christie is Entitled to Effective Filing Date of Christie Provisional

Christie has an effective filing date of June 9, 2013, the filing date of Christie

Provisional, because "the disclosure of the provisional application provides support for the claims" of Christie in compliance with §112. *See Dynamic Drinkware, LLC v. National Graphics, Inc.*, 800 F.3d 1375, 1381 (Fed. Cir. 2015); §120. At least claim 28 of Christie is fully supported by Christie Provisional under §112 as indicated in the claim chart provided by Dr. Cossairt. APPL-1004, ¶¶54-55. In fact, claim 28 of Christie is identical to claim 1 of the Christie Provisional, and each disclosure from Christie upon which Petitioner relies is also disclosed in Christie Provisional. *Id.* Accordingly, under *Dynamic Drinkware*, Christie is entitled to the benefit of Christie Provisional's June 9, 2013 filing date and is prior art as of that effective filing date.

3. Summary of Golan

Golan is titled "Continuous Electronic Zoom for an Imaging System with Multiple Imaging Devices Having Different Fixed FOV." Golan, Title; APPL-1004, ¶56. Like Parulski, Golan envisions use of wide and tele lenses and employs wide and tele images during digital zooming, which "facilitates a light weight electronic zoom with a large lossless zooming range." Golan, [0009]; APPL-1004, ¶57. Specifically, as illustrated in FIG. 1 below, Golan discloses zoom control sub-system 100 for an image acquisition system including "multiple image sensors, each with a fixed and preferably different FOV." Golan, [0036]-[0037]; APPL-1004, ¶57.

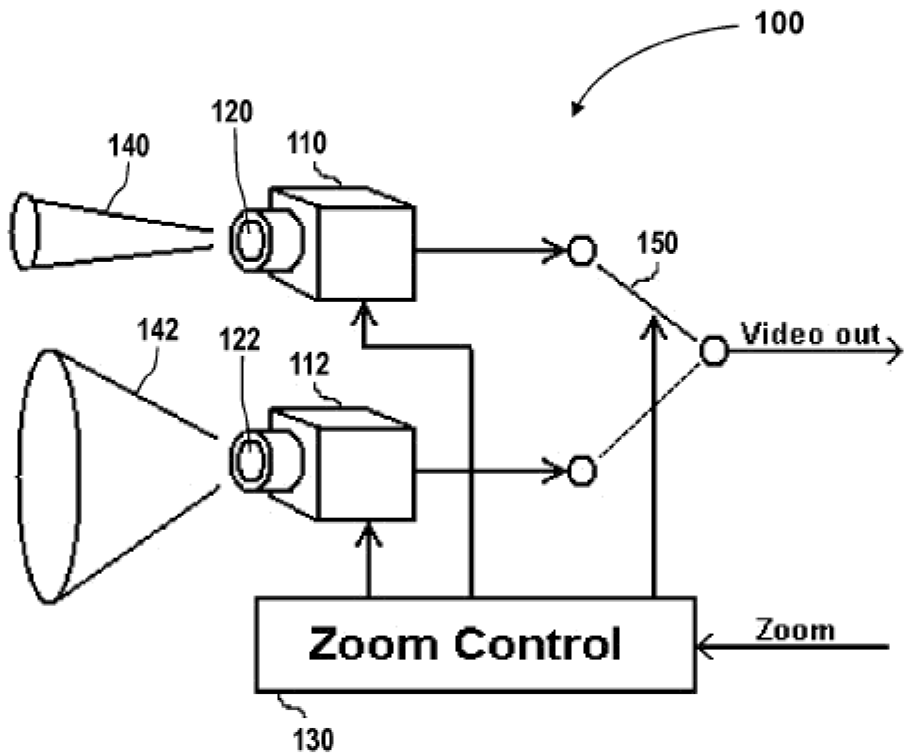


Fig 1

Golan, FIG. 1

Golan teaches that, in embodiments of FIGS. 1 and 2, each image frame of video output is generated based on an acquired image frame from "**the relevant image sensor**" of an image acquisition device selected based on the user input zoom factor, and as such, is generated without fusion. Golan, FIGS. 1-2, [0039]; APPL-1004, ¶58. Golan goes on to describe providing a video output with "continuous electronic zoom capabilities with uninterrupted imaging," which "is also maintained when switching back and forth between adjacently disposed image sensors." APPL-

1011, [0040]; APPL-1004, ¶59.

4. Reasons to Combine Parulski and Christie

A POSITA would have been motivated to combine the still/video mode and user interface teachings of Christie with Parulski's camera phone using multiple lenses and multiple sensors to produce the obvious, beneficial, and predictable results of a dual-lens camera phone with conserved power, increased time between battery charges, high quality still output images and high frame rate video output images, and faster and more efficient user interfaces. APPL-1004, ¶¶60-71.

Parulski and Christie are analogous prior art and are in the same field of endeavor pertaining to digital imaging systems operating in still/video mode for portable battery operated devices. APPL-1006, FIGS. 15A and 15B, 12:35-36, 23:4-7; APPL-1007, [0003], [0005]-[0006]; APPL-1008, [0002], [0004]-[0005]; APPL-1004, ¶61. A POSITA looking to improve upon a camera phone of Parulski would naturally have considered the teachings of Christie, a patent from Apple, a top provider of camera phones. APPL-1004, ¶62.

A POSITA would have been motivated to incorporate Christie's teachings that HDR is available in still mode but not available in video mode in the system of Parulski to obtain the benefits of conserved power, increased time between battery charges, high quality still output images, and high frame rate video output images. APPL-1004, ¶¶63-68.

First, a POSITA would have recognized that Christie's teachings of providing HDR in still mode but not in video mode provide benefits of conserved power and increased time between battery charges. APPL-1004, ¶64. HDR typically improves image quality by using sophisticated computationally expensive algorithms. *Id.*; *see also, e.g.*, APPL-1009, 1 (describing using "pretty sophisticated algorithms" to produce an HDR photo). In Christie, by limiting HDR to still mode, computing load (e.g., for CPU 12 of portable multifunction device 100) is reduced, reducing power consumption by the processor, and in turn, increasing time between battery charges. APPL-1004, ¶64.

Parulski acknowledges that for video images, its image augmentation process for improved dynamic range is applied to "the series of images constituting the video image signal." APPL-1006, 29:8-20; APPL-1004, ¶65. A POSITA would have understood that in Parulski, applying the image augmentation process for improved dynamic range to the series of images in the video (e.g., with a typical frame rate of 24-60 frames per second (fps)) would generate a large computing load on image processor 50, which would, in turn, increase power consumption and reduce battery life. APPL-1004, ¶65. Parulski already suggested power management is a design concern by including "power management components" in its design. APPL-1006, FIG. 15B, 23:47-49; APPL-1004, ¶65.

A POSITA would have understood that battery life is an important design

factor in power management, and would have been motivated to modify the video mode process of Parulski's camera phone by applying Christie's teachings of providing HDR in still mode but not in video mode to obtain the benefit of conserved power and increased time between battery charges. APPL-1004, ¶66.

Second, a POSITA would have recognized that Christie's teachings of providing HDR in still mode but not in video mode provide both high quality still output images and high frame rate video output images. APPL-1004, ¶67. HDR typically improves image quality by using sophisticated but computationally expensive algorithms, and requires more processing time. *Id.*; *see also, e.g.,* APPL-1009, 1. By applying Christie's teachings of video mode output images without HDR, per-frame processing time for video is reduced, allowing a high frame rate that a POSITA would have understood to be "**more important** than having the highest possible resolution or color fidelity" in video mode. APPL-1017, Abstract, [0020], [0043]-[0044]; APPL-1004, ¶67. Thus, a POSITA would have been motivated to apply Christie's teachings of providing HDR in still mode but not in video mode in Parulski's dual-lens camera phone, because the combination would provide the benefits of providing both high quality still images and high frame rate video output images. APPL-1004, ¶68.

Dr. Cossairt also testifies that a POSITA would have been motivated to incorporate Christie's teachings on gesture-based user interfaces in the system of

Parulski to obtain the benefits of faster and more efficient user interfaces, conserved power, and increased time between battery charges. APPL-1004, ¶¶69-70.

5. Reasons to Combine Golan with Parulski and Christie

A POSITA would have been motivated to combine the teachings of Golan with the system taught by Parulski in view of Christie, and to apply Golan's teachings to provide, without fusion, video images with continuous zoom, uninterrupted imaging, and a large lossless zooming range in the system of Parulski and Christie. APPL-1004, ¶¶72-76.

First, the references are analogous prior art and are in the same field of endeavor (digital imaging system). APPL-1011, FIGS. 1, 2, Abstract, [0036]; APPL-1004, ¶73.

Second, Golan teaches continuous zoom with uninterrupted imaging without fusion, and such "**continuous electronic zoom with uninterrupted imaging is <u>also maintained when switching back and forth</u>** between adjacently disposed image sensors." APPL-1011, FIGS. 1, 2, Abstract, [0040], [0046]-[0049]; APPL-1004, ¶74. A POSITA would have understood that in the system of Parulski in view of Christie, "digital zooming **between the wide angle and the telephoto focal lengths**" switches between the Wide and Tele sensors adjacently disposed, and could introduce discontinuity in the video. APPL-1006, FIGS. 15B, 16A, 16B, 23:54-58; *see also* APPL-1006, FIG. 8, 15:54-57, 18:25-33; APPL-1004, ¶74. A

POSITA would have been motivated to apply Golan's teachings in the system of Parulski in view of Christie to obtain the benefits of continuous zoom video images with uninterrupted imaging without fusion, such continuous zoom with uninterrupted imaging also maintained when switching between wide and tele sensors. APPL-1004, ¶74.

Third, Golan teaches switching between wide and tele sensors during digital zooming that "facilitates a light weight electronic zoom with **a large lossless zooming range**." APPL-1011, [0009]; APPL-1004, ¶75. Dr. Cossairt testifies that a POSITA would have been motivated to apply Golan's switch setting for switching between wide and tele sensors in the system of Parulski in view of Christie to obtain the benefits of a large lossless zoom range. APPL-1004, ¶75.

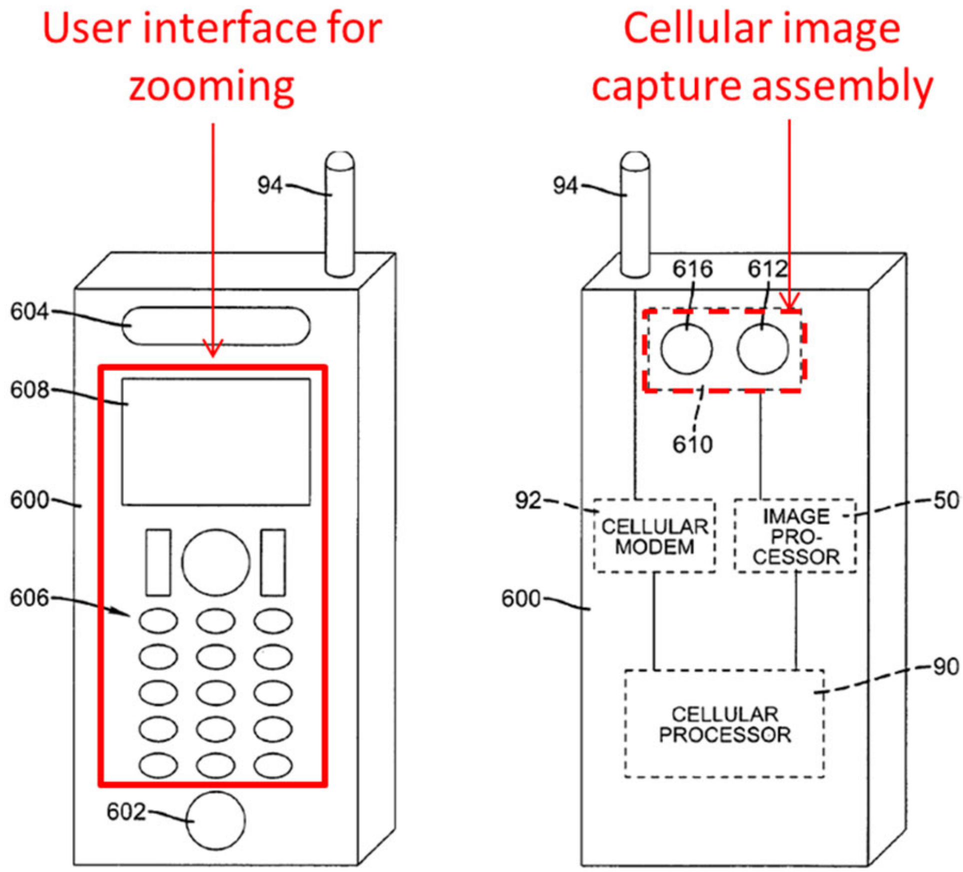
Finally, it would have been within the ability of a POSITA to implement Golan's teachings of zoom control system including calibrated alignment offsets between sensors and switch setting for switching between wide and tele sensors in the system of Parulski and Christie to obtain the benefits of providing, without fusion, continuous zoom video images with uninterrupted imaging with a large lossless zooming range. APPL-1004, ¶76. A POSITA would have expected the combination to produce operable results that are predictable. *Id.* Indeed, the combination is simply the use of a known technique (zoom control system design for a dual-lens digital camera as taught by Golan) to improve the similar device (a

dual-lens digital camera) of Parulski and Christie) in the same way. *Id.*

6. Claim 1

[1.0] ***A zoom digital camera comprising:***

Parulski teaches limitation [1.0]. APPL-1004, ¶¶76-80. Parulski provides "a multi-lens **digital camera** utilizing both (or more) images to provide an improved output image without unduly increasing the size or cost of the camera." APPL-1006, Abstract, 7:28-31; APPL-1004, ¶77. Parulski's camera phone 600 includes cellular image capture assembly 610, including fixed focal length wide angle lens 612 and fixed focal length telephoto lens 616. APPL-1006, 23:16-20, 23:33-43; APPL-1004, ¶78.



APPL-1006, FIGS. 15A and 15B, annotated

Parulski explains that image processor 50 of camera phone 600 "may provide **digital zooming** between the wide angle and the telephoto focal lengths; **the user may initiate such zooming** via a user interface displayed on the (LCD) display 608 and by keying appropriate buttons on the keypad 606" of camera phone 600. APPL-1006, FIG. 15A, 23:54-61; APPL-1004, ¶79. Parulski also describes an image augmentation process is used to "produce a digital image with improved resolution during **digital zooming**" "by combining a portion of the first

wide angle digital image and a portion of the telephoto digital image." APPL-1006, 29:51-67; APPL-1004, ¶79; *see also* APPL-1006, FIG. 23, 27:8-15 (determining a primary image and a secondary image of the image augmentation process based on the relationship between zoom factor and the zoom ranges of the capture units).

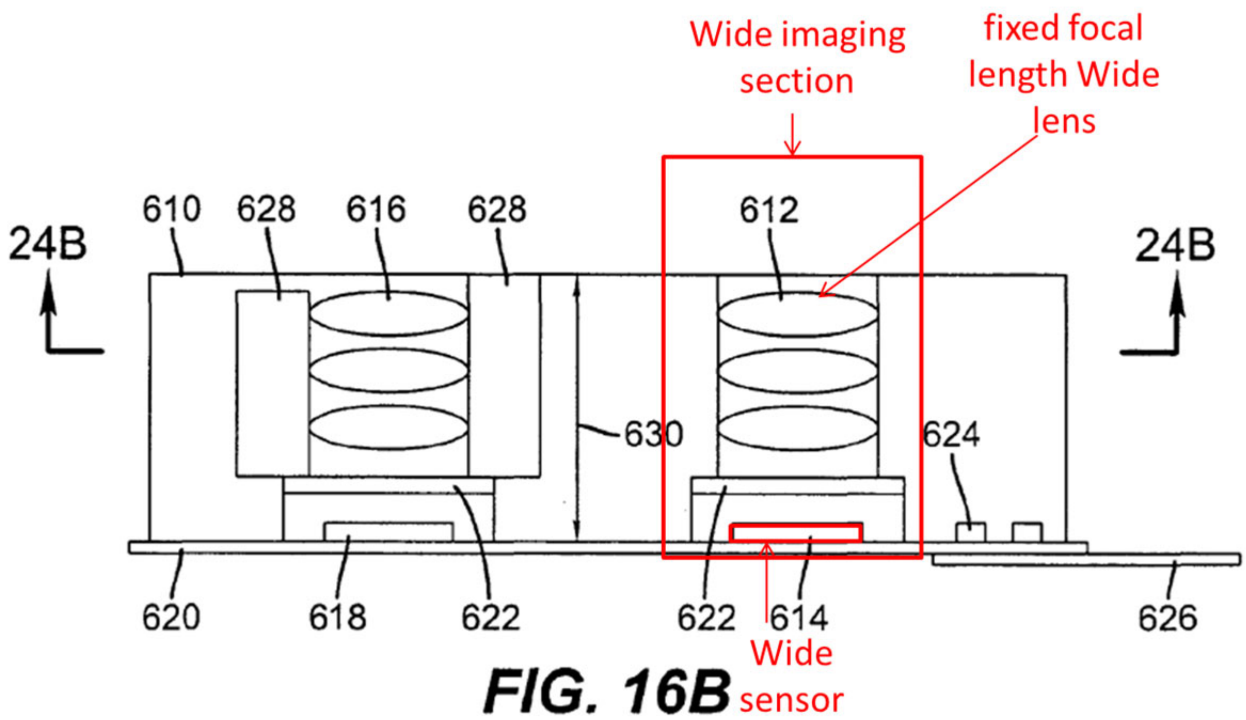
Parulski goes on to explain that the zoom images may be obtained in both still and video modes. APPL-1004, ¶80. Specifically, Parulski teaches its dual lens image capture assembly may operate in still and video modes to produce "**still images and motion video images**." APPL-1006, 12:36-41, 14:5-9; APPL-1004, ¶80.

Therefore, Parulski's camera phone 600 including a cellular image capture assembly 610 and an image processor 50 providing digital zooming based on user input teaches "*[a] zoom digital camera*" as recited in the claim. APPL-1004, ¶81.

[1.1] ***a) a Wide imaging section that includes a fixed focal length Wide lens with a Wide field of view (FOV), a Wide sensor and a Wide image signal processor (ISP), the Wide imaging section operative to provide Wide image data of an object or scene;***

Parulski teaches limitation [1.1]. APPL-1004, ¶¶82-93.

First, Parulski teaches a fixed focal length Wide lens with a Wide field of view (FOV). APPL-1004, ¶83. Relative to FIG. 16B below, Parulski teaches that camera phone 600 includes "first lens 612, preferably **a fixed focal length wide angle lens**." APPL-1006, 23:33-38; APPL-1004, ¶83.



APPL-1006, FIG. 16B, annotated

Parulski describes that "lens 612 [is] preferably a fixed focal length wide angle lens (such as a **40 mm equiv.** lens)." APPL-1006, 23:36-40; APPL-1004, ¶86. Parulski also teaches that a fixed focal length lens (e.g., lens 612) of a first image capture stage may "generate[] an ultra-wide angle field of view, e.g., **22 mm equiv**." APPL-1006, 21:57-61; APPL-1004, ¶86. Dr. Cossairt confirms that a POSITA would have understood that lens 612 has a Wide FOV determined based on its equivalent focal length (e.g., 28 and 44 degrees corresponding to "40 mm equiv." and "22 mm equiv." respectively). APPL-1004, ¶¶84-87.

Dr. Cossairt provides detailed testimony regarding FOV, and explains basic photographic geometrics with reference to a photography textbook. APPL-1004,

¶¶84-85. In particular, a POSITA would have recognized that FOV in the '291 Patent is defined as "measured from the center axis to the corner of the sensor (i.e. **half the angle of the normal definition**)," (APPL-1001, 6:56-58), which corresponds to the semi-angle of view θ of FIG. 4.13 of Jacobson calculated as:

$$\mathrm{FOV} = \theta = \tan^{-1}\left(\frac{K}{2f}\right), \qquad (1)$$

where K is a sensor diagonal size and f is a focal length of the lens. APPL-1004, ¶85; APPL-1016, 48.

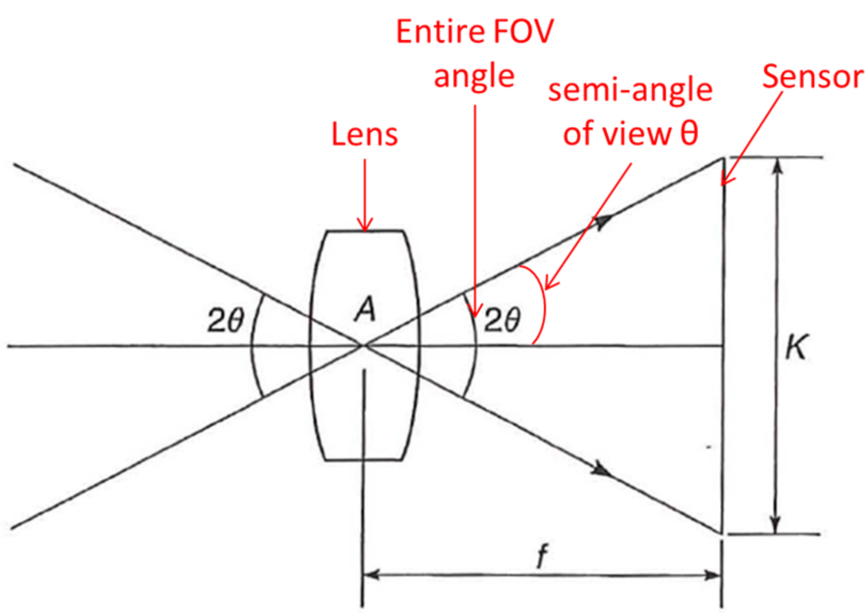


Figure 4.13 Field (angle) of view (FOV) of a lens related to format dimension

APPL-1016, FIG. 4.13, annotated

Second, Parulski teaches a Wide sensor 614, where "**first lens 612** ... **forms an image on the first image sensor 614**." APPL-1006, 44-47; APPL-1004, ¶88. Parulski explains that "the **wide angle image sensor 614** may have high resolution ...

in order to provide a higher quality source image for the digital zooming." APPL-1006, 23:58-61; APPL-1004, ¶88.

Third, Parulski teaches a Wide image signal processor (ISP). APPL-1004, ¶¶89-91. Parulski explain that in embodiments of FIGS. 16A and 16B, "similarly as was explained in connection with FIG. 1, an analog output signal from the first image sensor 614 is amplified by **a first analog signal processor**." APPL-1006, 24:36-42; APPL-1004, ¶89. Relative to FIG. 1 below, Parulski teaches that digital camera 10A "is included **as part of a camera phone**," for example, camera phone 600, where "one (or **both**) of the zoom lenses 3 and 4 could be **replaced with a fixed focal length lens**." APPL-1006, 13:4-6, 15:31-32; *see also* APPL-1006, 23:4-7; APPL-1004, ¶89. Parulski explains that "analog output signal 12e from **the first image sensor 12 is amplified and converted to a first digital image signal by a first analog signal processor 22**." APPL-1006, 13:48-53; APPL-1004, ¶89. Further, Parulski teaches capturing images "using the **shorter focal length first image capture stage** and the longer focal length second image capture stage." APPL-1006, 17:62-66; APPL-1004, ¶90. Therefore, Parulski teaches its first image capture stage (e.g., first imaging stage 1 of FIG. 1) includes the Wide lens, and as such, first image sensor 12 and first analog signal processor 22 of first imaging stage 1 correspond to first image sensor 614 and first analog signal processor of camera phone 600 respectively. APPL-1004, ¶90.

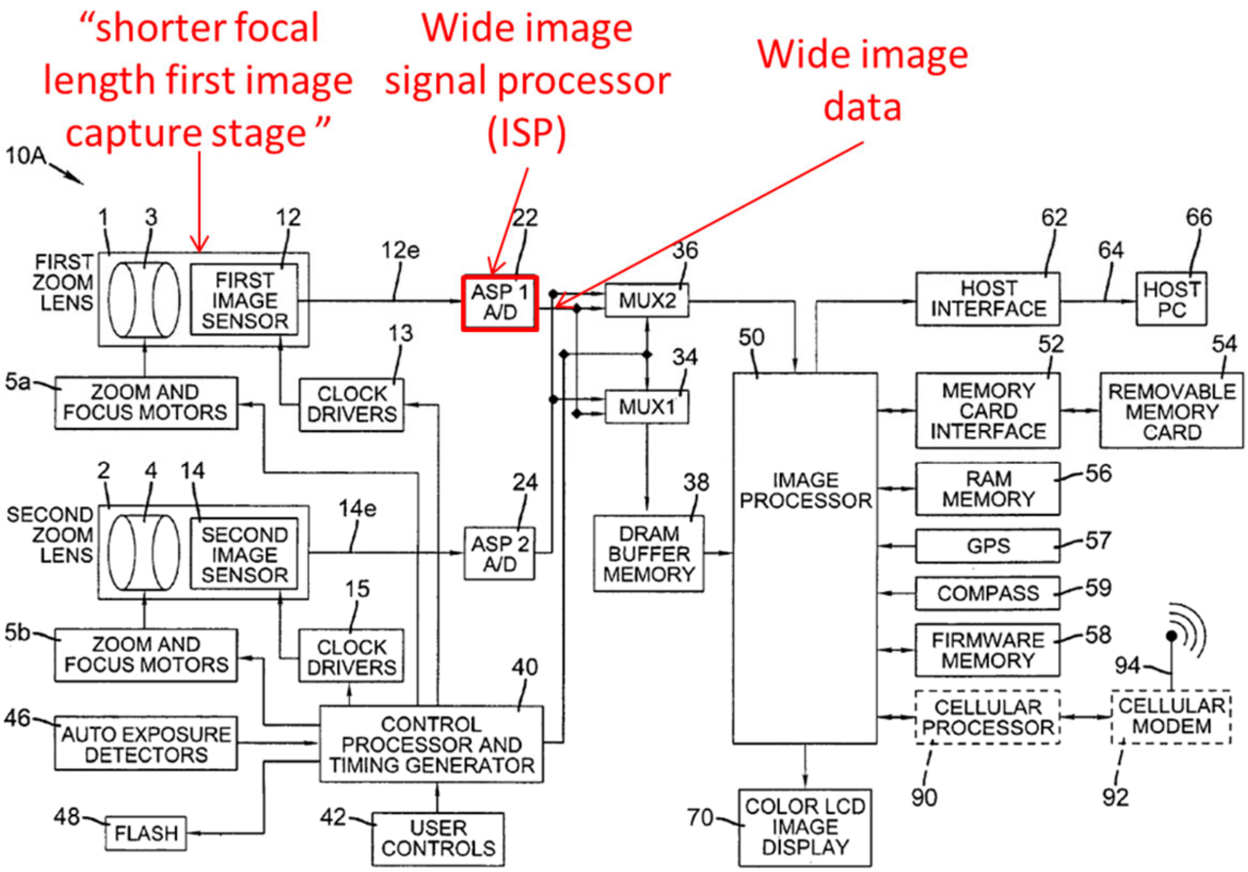


FIG. 1

APPL-1006, FIG. 1, annotated

As shown in FIG. 1, Parulski also describes that image processor 50 receives data from first image sensor 12, and performs "various other image processing functions." APPL-1006, 14:57-63; APPL-1004, ¶91. Thus, in Parulski, a wide image pipeline includes analog and digital processing components (e.g., first analog signal processor 22 and image processor 50). APPL-1004, ¶91. At least Parulski's first analog signal processor 22 performs signal processing on the wide image signal from first image sensor 614, and corresponds to Wide ISP as claimed. *Id.*; APPL-1018, 7.

To the extent Patent Owner argues that digital processing of image processor 50 is necessary to its Wide ISP, Dr. Cossairt confirms that allocation of signal processing to particular components is a matter of design choice and that it was well known in the art of dual image sensor cameras to maintain separateness of Wide and Tele image pipelines through digital signal processing. APPL-1004, ¶91; APPL-1022, FIG. 2, [0031], [0036]-[0038].

Fourth, Parulski teaches that a Wide imaging section is operative to provide Wide image data of an object or scene, where the Wide imaging section includes lens 612, image sensor 614, first analog signal processor 22, and image processor 50. APPL-1004, ¶92. Specifically, "**first lens 612** ... **forms an image on the first image sensor 614**," and an analog output signal from image sensor 614 is "amplified and converted to **a first digital image signal** by a first analog signal processor 22." APPL-1006, 13:48-53, 23:28-43; APPL-1004, ¶92. Image processor 50 may further perform "image processing functions" to that first digital image signal. APPL-1006, 14:57-63; APPL-1004, ¶92. As such, the first digital image signal provided by the Wide imaging section corresponds to the Wide image data as claimed. APPL-1004, ¶92.

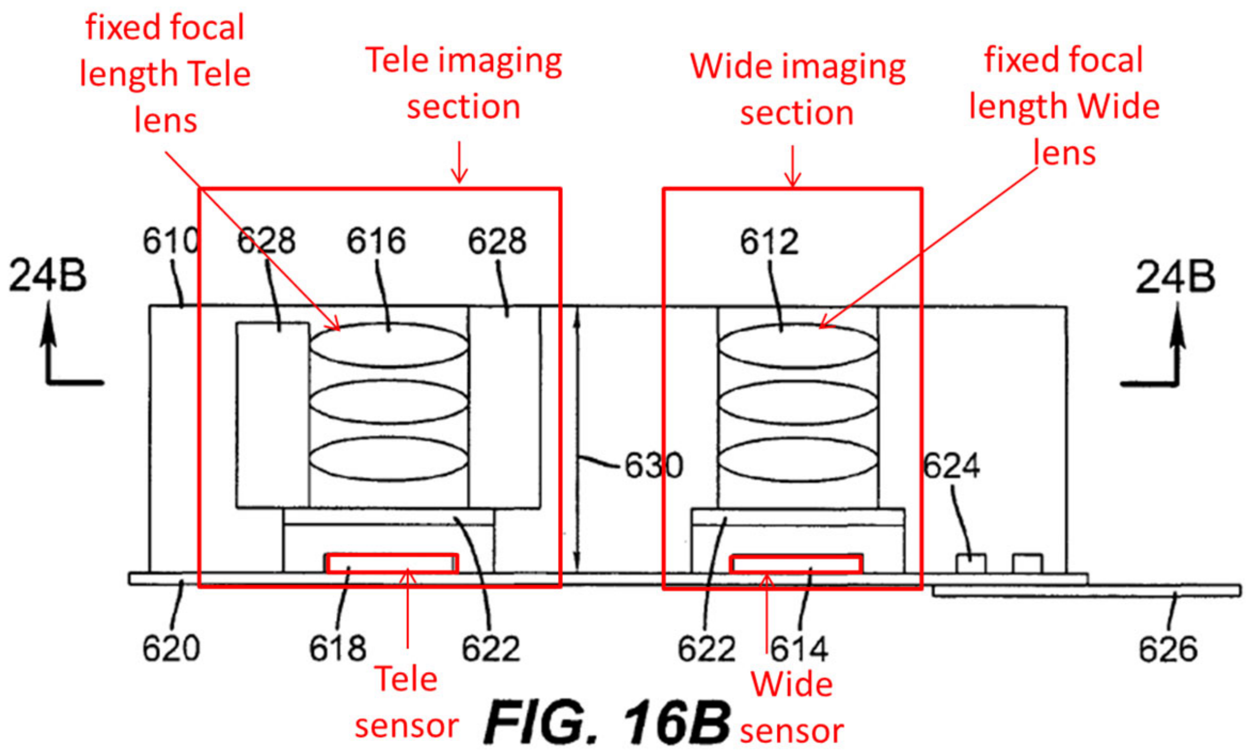
Therefore, Parulski's camera phone 600 includes a Wide imaging section including (i) fixed focal length wide angle lens 612 with a Wide FOV, (ii) image sensor 614, and (iii) a Wide ISP including first analog signal processor 22, and is

operative to provide a first digital image signal of a scene in front of lens 612, which teaches "*a Wide imaging section that includes a fixed focal length Wide lens with a Wide field of view (FOV), a Wide sensor and a Wide image signal processor (ISP), the Wide imaging section operative to provide Wide image data of an object or scene*" as recited. APPL-1004, ¶93.

[1.2] ***b) a Tele imaging section that includes a fixed focal length Tele lens with a Tele FOV that is narrower than the Wide FOV, a Tele sensor and a Tele ISP, the Tele imaging section operative to provide Tele image data of the object or scene; and***

Parulski teaches limitation [1.2]. APPL-1004, ¶¶94-102.

First, Parulski teaches a fixed focal length Tele lens with a Tele FOV that is narrower than the Wide FOV. APPL-1004, ¶95. Relative to FIG. 16B below, Parulski teaches that camera phone 600 includes "second lens 616, preferably **a fixed focal length telephoto lens**." APPL-1006, 23:38-40; APPL-1004, ¶95.



APPL-1006, FIG. 16B, annotated

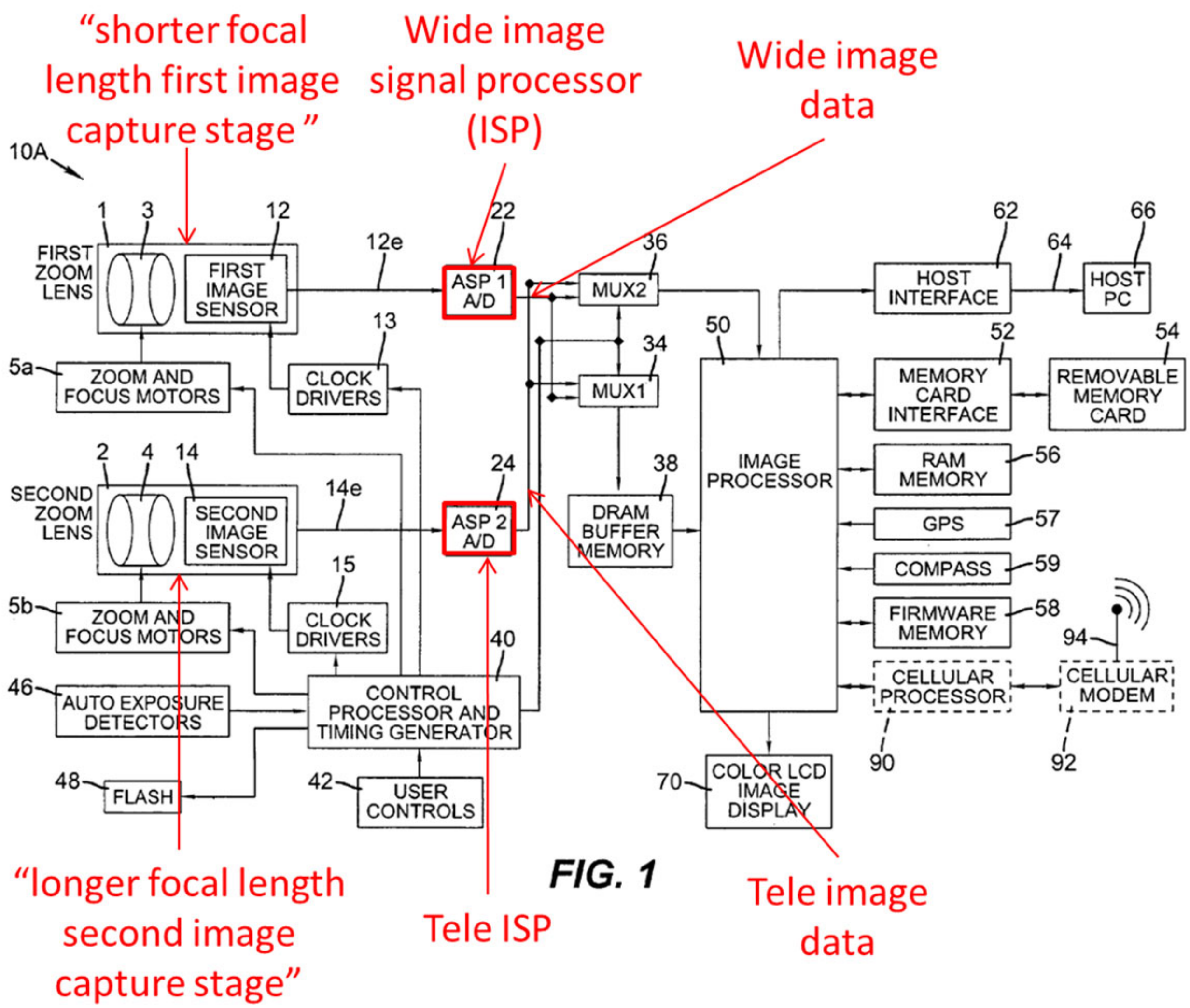
Parulski teaches that Tele lens 616 has a Tele FOV narrower than the Wide FOV of Wide lens 612. APPL-1004, ¶96. Parulski describes that Tele lens 616 may be "a fixed focal length telephoto lens (such as **100 mm equiv.** lens)." APPL-1006, 23:38-40; APPL-1004, ¶96. Dr. Cossairt confirms that a POSITA would have understood that telephoto lens 616 has a Tele FOV determined based on its equivalent focal length (e.g., 12 degrees corresponding to "100 mm equiv."), which is narrower than the Wide FOV (e.g., 28 degrees and 44 degrees corresponding to "40 mm equiv." and "22 mm equiv." respectively) of Wide lens 612. APPL-1004, ¶96.

Second, Parulski teaches a Tele sensor 618, where "**second lens 616** ... **forms**

an image on the second image sensor 618." APPL-1006, 23:44-47; APPL-1004, ¶97. Parulski explains that "the wide angle image sensor 614 may have high resolution, e.g., higher than that of the **<u>telephoto image sensor 618</u>**, in order to provide a higher quality source image for the digital zooming." APPL-1006, 23:58-61; APPL-1004, ¶97.

Third, Parulski teaches a Tele ISP. APPL-1004, ¶98. Parulski explains that in camera phone 600, "**similarly as was explained in connection with FIG. 1**," "[t]he analog output signal from the second image sensor 618 is **amplified by a second analog signal processor**." APPL-1006, 24:36-45, 13:53-56; APPL-1004, ¶98. As shown in FIG. 1 below, Parulski explains "analog output signal 14e from the **second image sensor 14 is <u>amplified and converted</u> to a second digital image signal by <u>a second analog signal processor 24</u>**." APPL-1006, 13:53-56; APPL-1004, ¶98.

Parulski teaches capturing images "using the shorter focal length first image capture stage and the **<u>longer</u> focal length <u>second</u> image capture stage**." APPL-1006, 17:62-66; APPL-1004, ¶99. Therefore, Parulski teaches its second image capture stage (e.g., second imaging stage 2 of FIG. 1) includes the Tele lens, and as such, second image sensor 14 and second analog signal processor 24 of FIG. 1 correspond to second image sensor 618 and second analog signal processor of camera phone 600 respectively. APPL-1006, 13:53-59; APPL-1004, ¶99.



APPL-1006, FIG. 1, annotated

As shown in FIG. 1, Parulski also describes that image processor 50 receives data from second image sensor 14 and performs "various other image processing functions." APPL-1006, 14:57-63; APPL-1004, ¶100. Thus, in Parulski, a tele image pipeline includes analog and digital processing components (e.g., second analog signal processor 24 and image processor 50). APPL-1004, ¶100. At least Parulski's second analog signal processor 24 performs signal processing to the tele

image signal from second image sensor 618, and corresponds to Tele ISP as claimed. APPL-1004, ¶100; APPL-1018, 7. To the extent that Patent Owner argues that digital processing of image processor 50 is necessary to its Tele ISP, Dr. Cossairt confirms that allocation of signal processing to particular components is a matter of design choice and that it was well known in the art of dual image sensor cameras to maintain separateness of Wide and Tele image pipelines through digital signal processing. APPL-1004, ¶100; APPL-1022, FIG. 2, [0031], [0036]-[0038].

Fourth, Parulski teaches that a Tele imaging section is operative to provide Tele image data of the object or scene of the Wide image data, where the Tele imaging section includes lens 616, image sensor 618, second analog signal processor 24 and image processor 50. APPL-1004, ¶101. Specifically, "**lens 616** ... **forms an image on the second image sensor 618**," and Wide lens 612 and Tele lens 616 "are oriented in in the same direction in order to **form images of the same portion of the overall scene** in front of them, albeit with different fields of view." APPL-1006, 23:28-43; APPL-1004, ¶101. Parulski also teaches that an analog output signal from Tele sensor 618 is "is amplified and converted to **<u>a second digital image signal</u>** **by a second analog signal processor 24**." APPL-1006, 13:53-56; APPL-1004, ¶101. Image processor 50 may further perform "image processing functions" to that second digital image signal. APPL-1006, 14:57-63; APPL-1004, ¶101. As such, the second digital image signal provided by the Tele imaging section

corresponds to the Tele image data as claimed. APPL-1004, ¶101.

Therefore, Parulski's camera phone 600 includes a Tele imaging section including (i) fixed focal length telephoto lens 616 with a telephoto FOV narrower than the Wide FOV of fixed focal length wide angle lens 612, (ii) image sensor 618, and (iii) a Tele ISP including second analog signal processor 24, and is operative to provide a second digital image signal of the same scene in front of lenses 612 and 616, which teaches "*a Tele imaging section that includes a fixed focal length Tele lens with a Tele FOV that is narrower than the Wide FOV, a Tele sensor and a Tele ISP, the Tele imaging section operative to provide Tele image data of the object or scene*" as recited. APPL-1004, ¶102.

[1.3] ***c) a camera controller operatively coupled to the Wide and Tele imaging sections,***

Parulski teaches limitation [1.3]. APPL-1004, ¶¶103-107.

First, Parulski discloses that camera phone 600 includes a Wide imaging section as discussed at [1.1], and includes a Tele imaging section as discussed at [1.2]. APPL-1004, ¶104. Parulski teaches capturing images "using the **<u>shorter</u>** focal length **<u>first</u> image capture stage** and the **<u>longer</u>** focal length **<u>second</u> image capture stage**." APPL-1006, 17:62-66; APPL-1004, ¶104. Parulski also teaches that that relative to FIG. 1, "one (or **both**) of the zoom lenses 3 and 4 could be **replaced with a fixed focal length lens**." APPL-1006, 13:4-6; APPL-1004, ¶104. As such, a first imaging

section including first image capture stage (e.g., first imaging stage 1) and first analog signal processor 22 corresponds to Wide imaging section of camera phone 600, and a second imaging section including first image capture stage (e.g., second imaging stage 2) and second analog signal processor 24 corresponds to Tele imaging section of camera phone 600. APPL-1006, 13:48-53; APPL-1004, ¶104.

Second, Parulski discloses a camera controller operatively coupled to the Wide and Tele imaging sections. APPL-1004, ¶105. As illustrated in FIG. 1 below, Parulski discloses that digital camera 10A includes a camera controller including clock drivers 13 and 15, control processor and timing generator 40, user controls 42, and image processor 50. APPL-1004, ¶105.

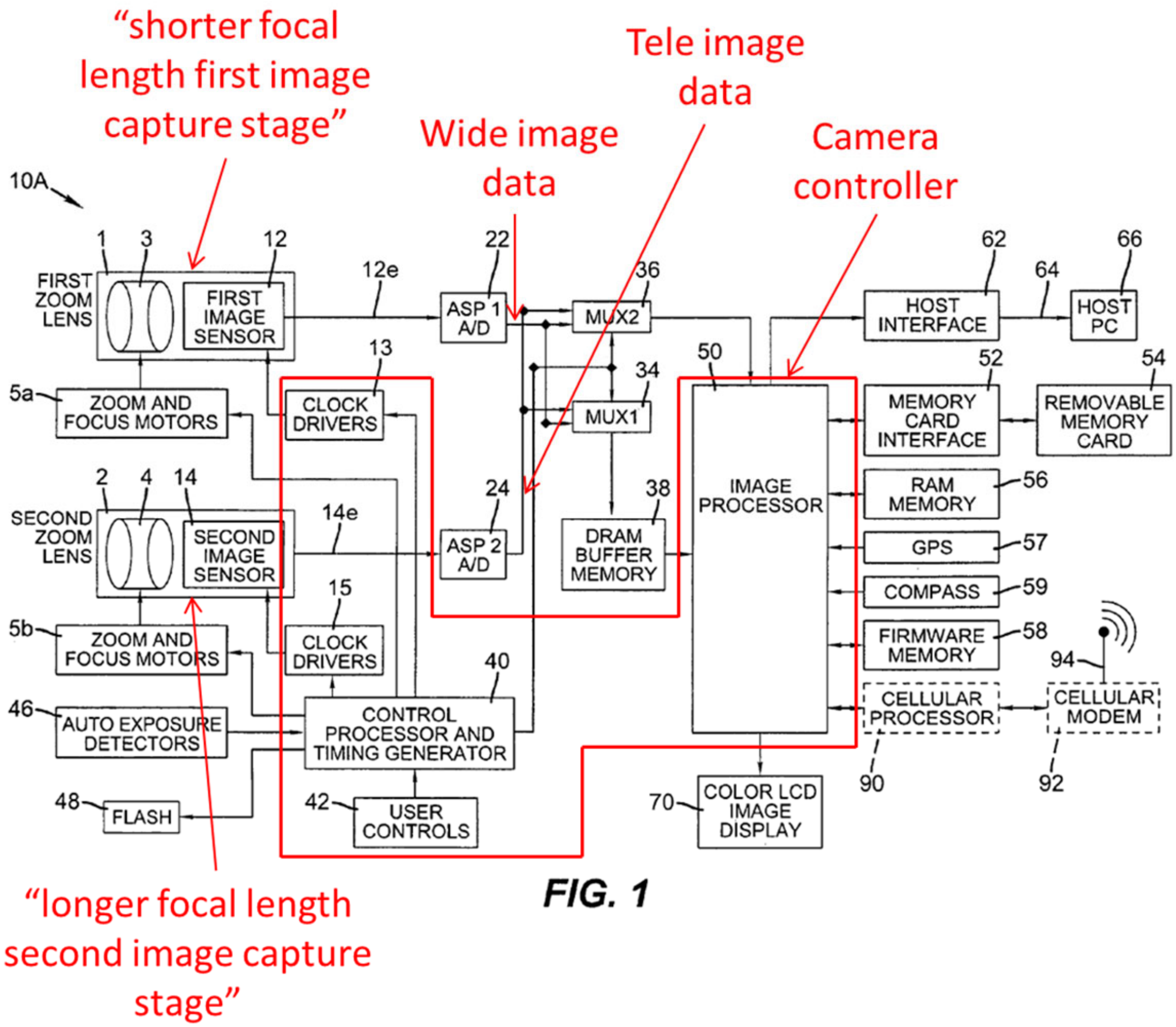


FIG. 1

APPL-1006, FIG. 1, annotated

As shown in FIG. 1 above, Parulski discloses that image processor 50 receives image data (Wide and Tele image data) from the first imaging section (Wide imaging section) and second imaging section (Tele imaging section) respectively, and "produce[s] a processed digital image file," and therefore, is operatively coupled to Parulski's first and second imaging sections. APPL-1006, 14:5-9, 27:25-31; APPL-1004, ¶106.

Parulski's camera controller including image processor 50 receives digital image data (Wide and Tele image data) from a first imaging section (e.g., first imaging stage 1 and first analog signal processor 22) (Wide imaging section) and a second imaging section (e.g., second imaging stage 2 and second analog signal processor 24) (Tele imaging section) respectively, which teaches "*a camera controller operatively coupled to the Wide and Tele imaging sections*" as recited. APPL-1004, ¶107.

[1.4] ***the camera controller configured to combine in still mode at least some of the Wide and Tele image data to provide a fused output image of the object or scene from a particular point of view and***

Parulski teaches limitation [1.4]. APPL-1004, ¶¶108-116.

First, as discussed at [1.3], Parulski discloses a first imaging section including first image capture stage (e.g., first imaging stage 1) and first analog signal processor 22 corresponds to Wide imaging section of camera phone 600, and a second imaging section including first image capture stage (e.g., second imaging stage 2) and second analog signal processor 24 corresponds to Tele imaging section of camera phone 600. APPL-1004, ¶109.

Second, Parulski discloses combining in still mode at least some of the Wide and Tele image data to provide a fused output image of the object or scene. APPL-1004, ¶110. Specifically, as explained with FIG. 26 below, Parulski describes an image augmentation process may be applied to "a **<u>still</u>** image," which "utilizes one of

the images from a dual-lens camera as a secondary image that can be used to **modify** the other, primary image and thereby generate an enhanced primary image." APPL-1006, FIG. 26, 7:21-24, 7:32-35, 28:19-40, 29:8-14; APPL-1004, ¶110. The enhanced primary image is an output image including information from the primary image and the secondary image. APPL-1006, FIG. 26; APPL-1004, ¶110. Therefore, the enhanced primary image corresponds to "*the fused output image*" as recited and construed, because the enhanced image is "an output image including information from two images" as discussed at V.A. APPL-1004, ¶¶110-111.

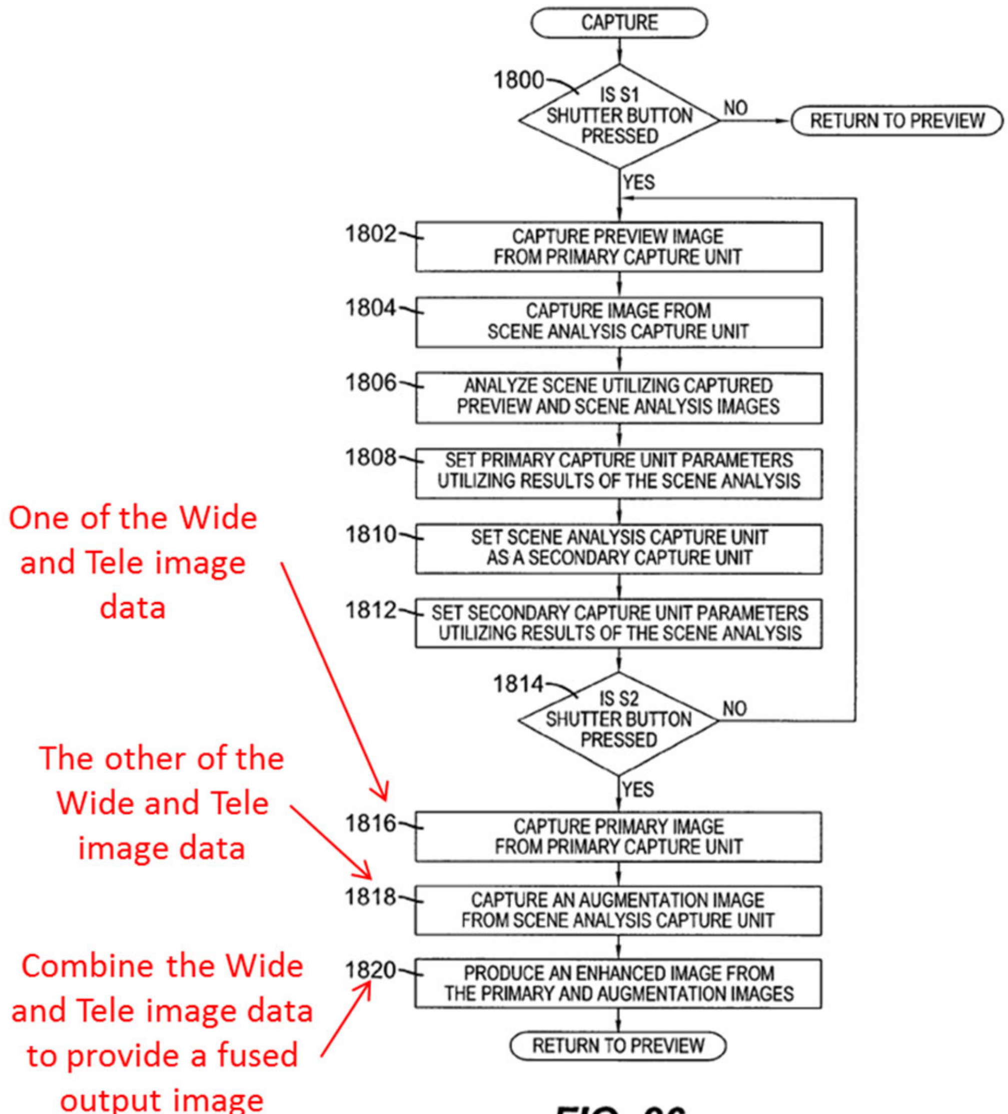
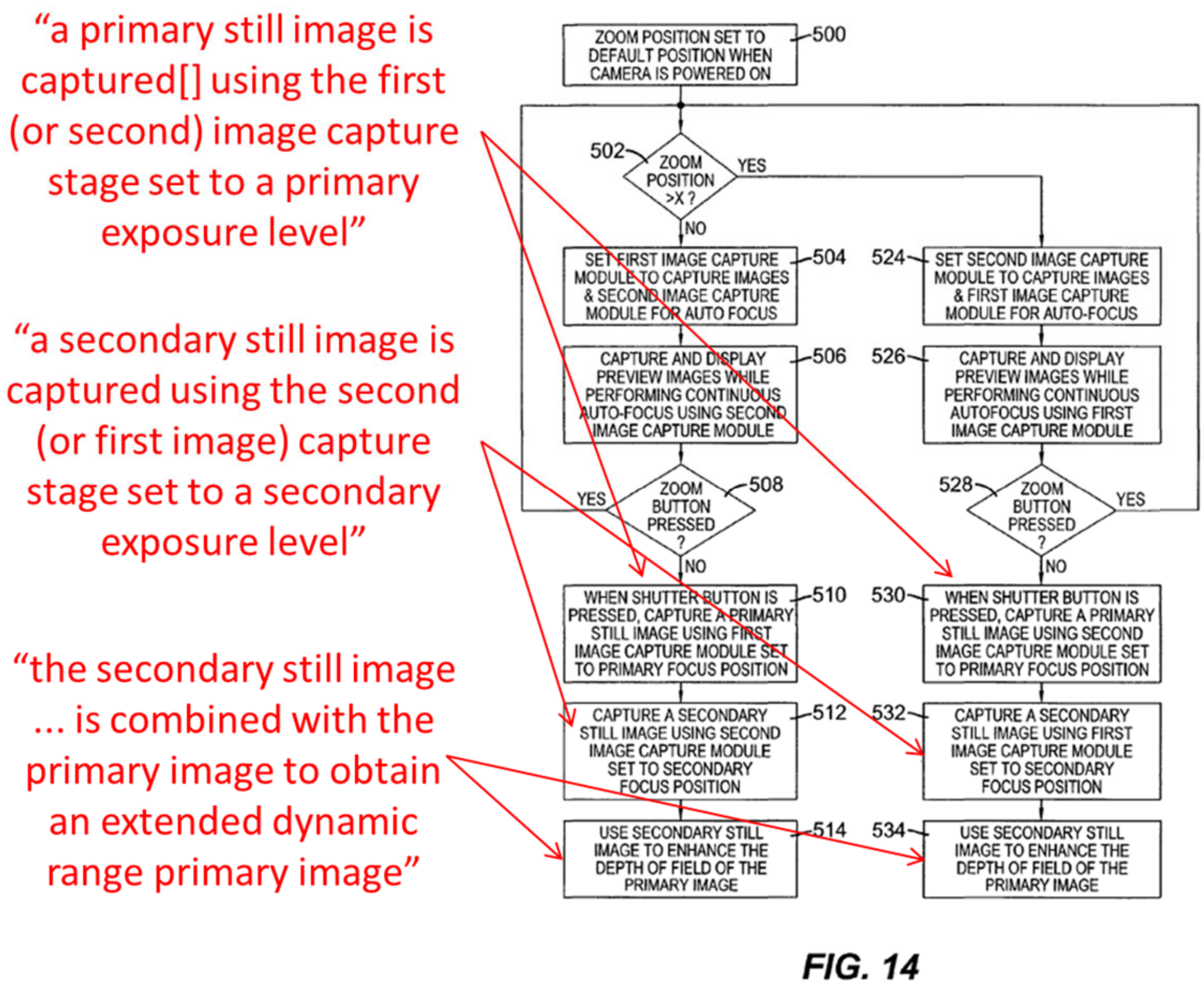


FIG. 26

APPL-1006, FIG. 26, annotated

Parulski describes different augmentation types for generating an enhanced primary image. APPL-1006, 29:29-35; APPL-1004, ¶112. For example, as shown in FIG. 14 below, a primary still image may be "**enhanced specifically for dynamic range**" using a secondary still image having different exposure levels. APPL-1006, FIG. 14, 29:21-35; APPL-1004, ¶112. Parulski also describes that the primary image

and secondary image may be combined, for example, "by **replacing portions** of the primary image with portions of the secondary image," or "by **considering the pixel values of both** the primary and secondary images." APPL-1006, 29:4-7; 36-44; APPL-1004, ¶¶112-113.



APPL-1006, FIG. 14, annotated

Third, Parulski discloses that its camera controller including image processor 50 is configured to perform, in still mode, the image augmentation process to generate a fused output image. APPL-1004, ¶114. For example, Parulski explains that in the

image augmentation process, "the image could be examined **by the image processor 50** for its dynamic range," and "an enhanced image is **produced by the image processor 50** from the primary and augmentation images." APPL-1006, 28:37-40, 28:58-60; APPL-1004, ¶114.

Fourth, Parulski discloses providing a fused output image from a point of view of the primary capture unit that provides the primary image (a particular point of view). APPL-1004, ¶115. For example, Parulski discloses that an enhanced primary image may be "created with a broadened dynamic range by **replacing portions of the primary image with portions of the secondary image**." APPL-1006, 29:4-7; APPL-1004, ¶115. A POSITA would have understood that the enhanced primary image is from the same point of view as the primary image, which is from the primary capture unit that provides the primary image. APPL-1004, ¶115; *see also, e.g.*, APPL-1013, FIG. 2.12, 51; APPL-1016, 5, 57-58.

Therefore, Parulski's camera controller including image processor 50 combines a secondary still image (one of the Wide and Tele image data) and a primary still image (the other of the Wide and Tele image data) of an object to obtain an enhanced still image (e.g., an extended dynamic range primary image) from a point of view of the primary image, which teaches that "*the camera controller configured to combine in still mode at least some of the Wide and Tele image data to provide a fused output image of the object or scene from a particular point of view*" as recited.

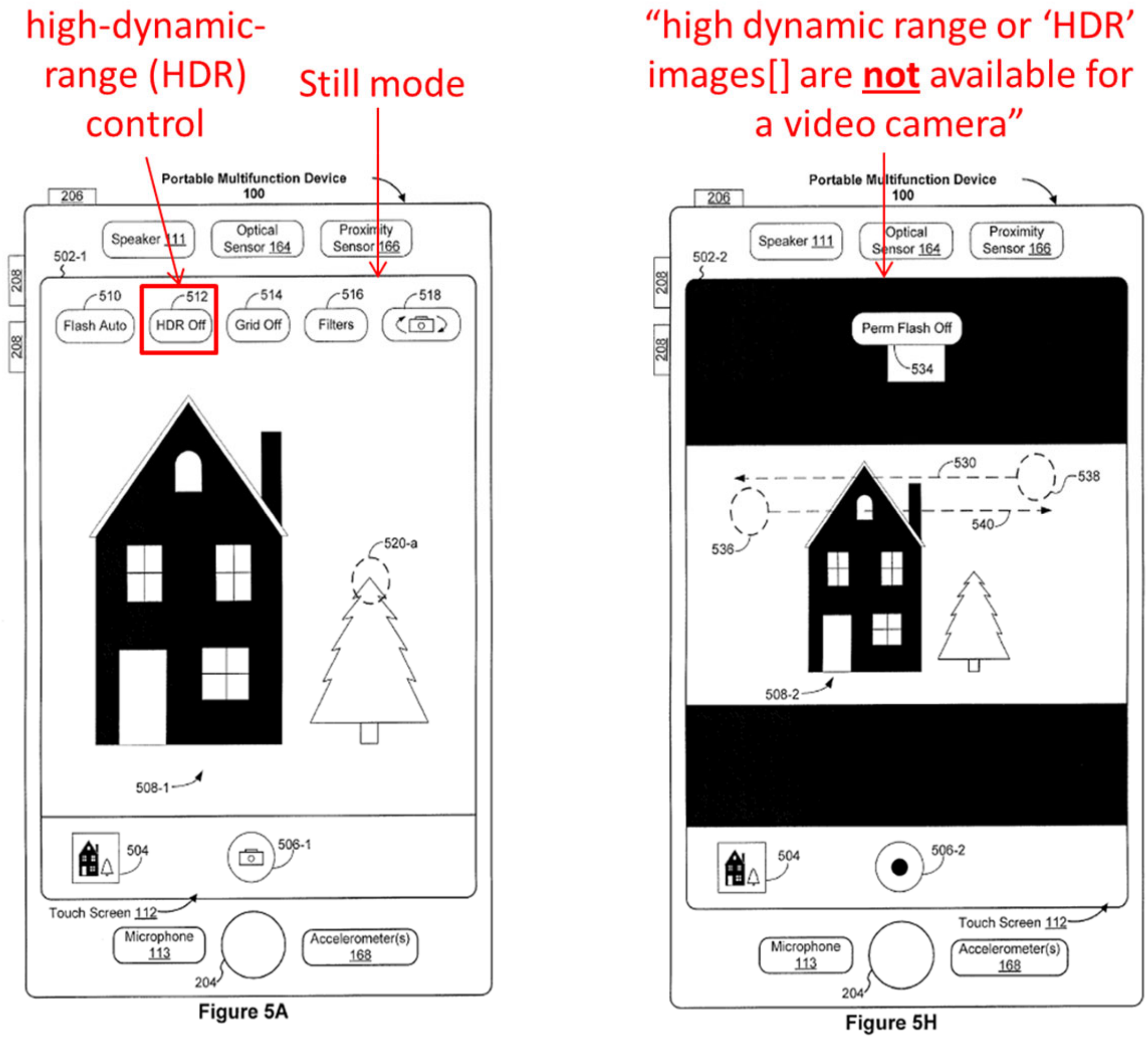
APPL-1004, ¶116.

[1.5] [the camera controller configured] ***to provide without fusion continuous zoom video mode output images of the object or scene, each output image having a respective output resolution;***

The combination of Parulski, Christie, and Golan teaches limitation [1.5]. APPL-1004, ¶¶117-129.

First, as discussed at [1.0], Parulski discloses that image processor 50 is configured to provide zoom video mode output images of the object or scene. APPL-1004, ¶118. As such, Parulski discloses that the camera controller including image processor 50 is configured to provide zoom video mode output images. APPL-1004, ¶118.

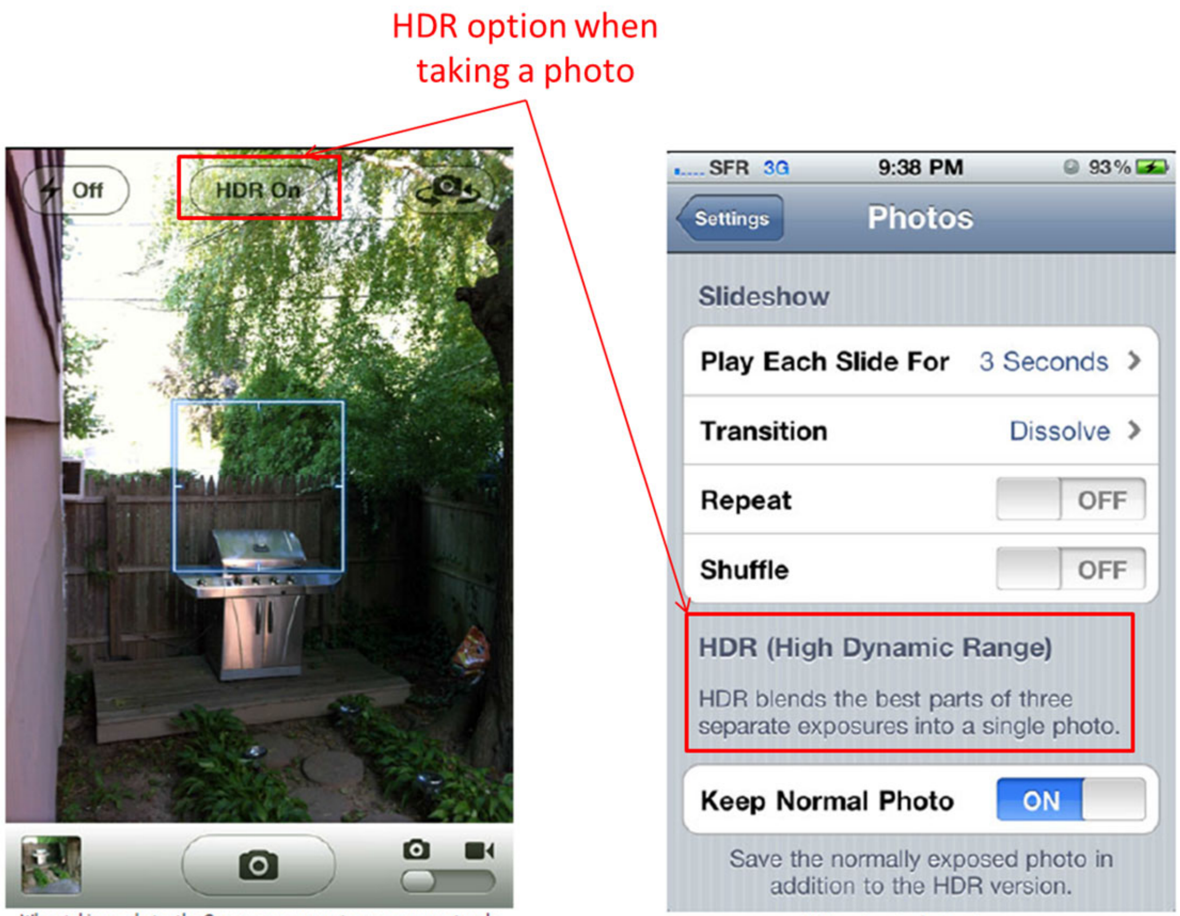
Second, Christie teaches that HDR is available in still mode but not available in video mode in a digital imaging system. APPL-1004, ¶119. Specifically, as shown in FIGS. 5A and 5H below, Christie teaches that its camera, in still mode (e.g., with camera interface 502-1 including HDR control 512), provides the HDR function for generating an HDR image, while no HDR function is available in the video mode (e.g. with camera interface 502-2). APPL-1007, [0163], [0172], [0175], [0202]; APPL-1004, ¶113. Christie also explicitly describes that "**still** image capture options such as **high dynamic range or 'HDR' images** ... are **not** available for a **video** camera." APPL-1007, [0202]; APPL-1008, [00162]; APPL-1004, ¶113.



APPL-1007, FIGS. 5A and 5H, annotated

A POSITA would have understood that Christie's HDR function only available in still mode provides a fused output image with improved dynamic range by combining two or more images of different exposures. APPL-1004, ¶120. For example, Parulski explains that an enhanced image with a broadened dynamic range is generated by combining a primary image and a secondary image having different exposures. APPL-1006, 7:62-66; 28:58-29:7; 29:20-34; APPL-1004, ¶120. *See also*

APPL-1009, 1, 4-5; APPL-1010, 126-127; APPL-1004, ¶120.



When taking a photo, the Camera app presents an on-screen toggle to switch HDR on or off, wedged between to the flash and camera swap controls.

HDR options in the Settings app.

APPL-1009, FIGS. at 4 and 5, annotated

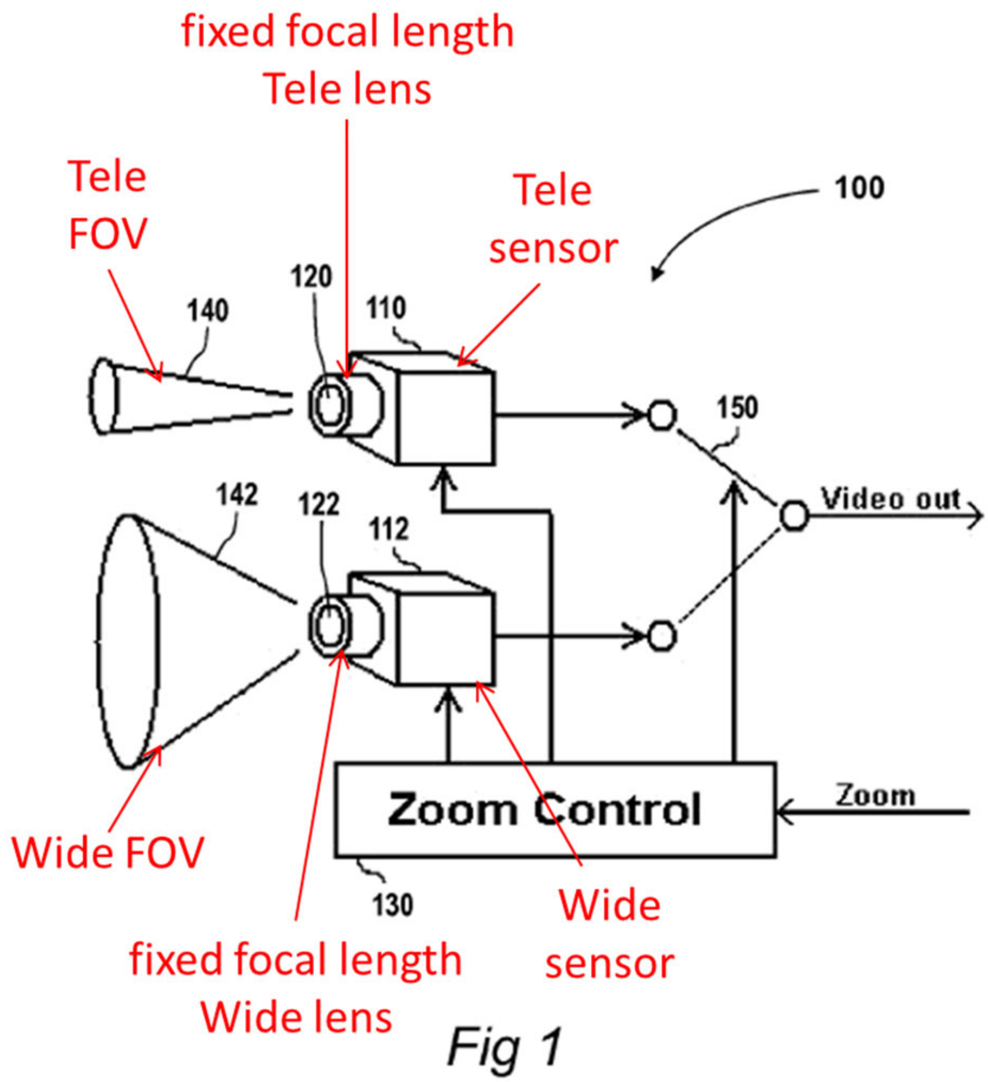
A POSITA would have been motivated to apply Christie's teachings that HDR is available in still mode but not available in video mode in the system of Parulski to obtain the benefits of conserved power, increased time between battery charges, high quality still output images, and high frame rate video output images. APPL-1004, ¶121. A POSITA would have understood that in a portable battery operated camera phone of Parulski, battery life is an important design factor in

power management, and would have been motivated to apply Christie's teachings of providing HDR in still mode but not in video mode in Parulski's dual-lens camera phone because the combination would provide the benefits of providing both high quality still images and high frame rate video output images, conserved power, and increased time between battery charges. APPL-1004, ¶121.

In the combination of Parulski and Christie, the camera controller of camera phone 600 including image processor 50 is configured to provide a fused output image in still mode (e.g., by applying Parulski's image argumentation for improved dynamic range) and to provide without fusion zoom video mode output images (e.g., generating the video output image based only on the primary image but not the secondary image by not applying the image augmentation process). APPL-1004, ¶122. Dr. Cossairt confirms that a POSITA would readily appreciate applicability of Christie's teaching (albeit exemplified relative to successively captured images in a single lens system) to the multi-lens system of Parulski. APPL-1004, ¶122. *See also* VIII.A.4: Reasons to Combine Parulski and Christie.

Third, Golan discloses providing, without fusion, continuous zoom video mode output images, each output image having a respective output resolution. APPL-1004, ¶123. Specifically, as illustrated in FIG. 1 below, Golan discloses zoom control subsystem 100 includes tele image sensor 110 coupled with narrow lens 120 having tele FOV 140, wide image sensor 112 coupled with wide lens 122 having wide FOV

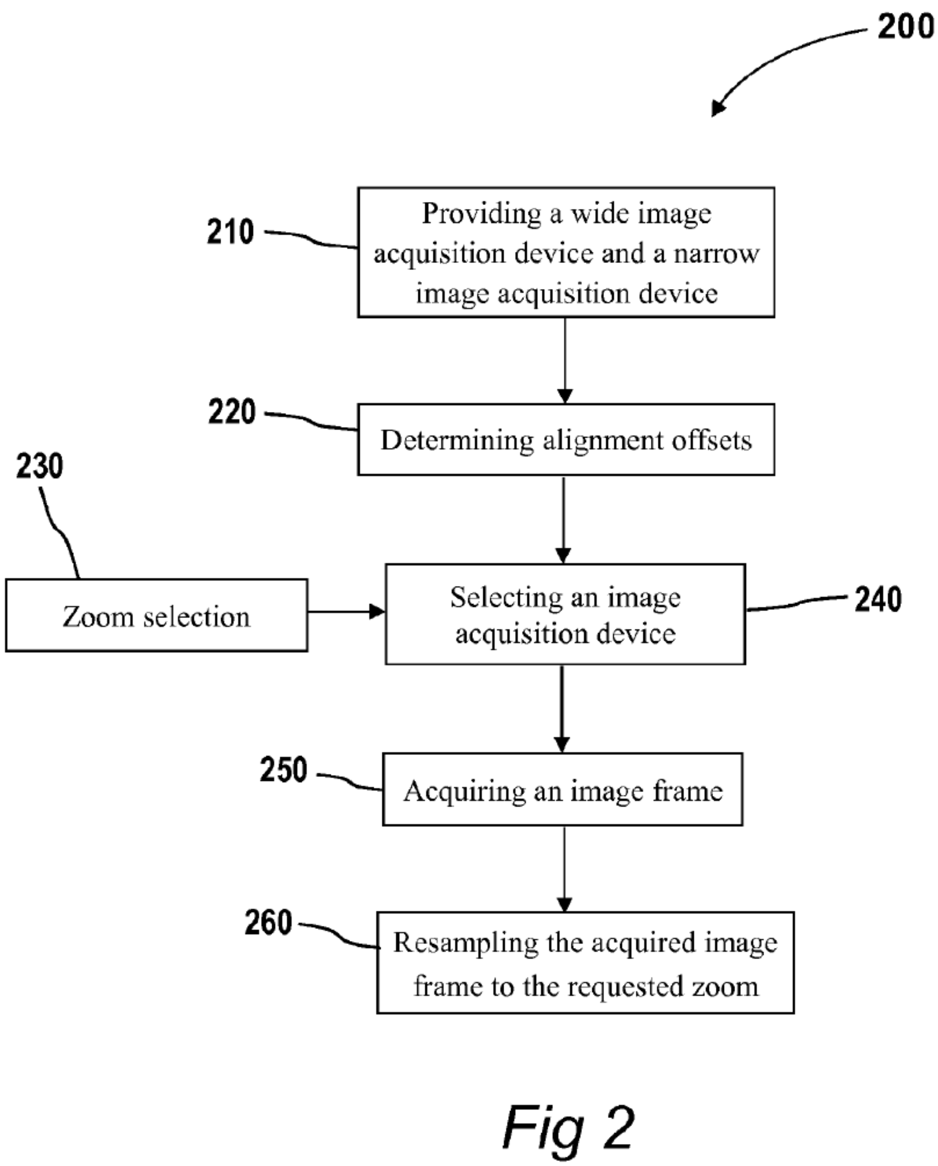
142, zoom control module 130 and image sensor selector 150. APPL-1011, [0036]-[0037], [0041]-[0044]; APPL-1004, ¶123.



APPL-1011, FIG. 1, annotated

Golan describes that in embodiments of FIG. 1 above and FIG. 2 below, a video output is generated by "**selecting one of the image acquisition devices** based on the requested zoom ... and performing digitally zoom on the acquired image frame, thereby obtaining an acquired image frame with the requested zoom." APPL-1011,

FIGS. 1, 2, Abstract, [0046]-[0049]; APPL-1004, ¶124. A POSITA would have recognized that such a video output is generated **without fusion** because an image frame of the video output is generated from only one acquired image from the selected image acquisition device, and therefore is **not** a fused output image that includes information from two images. APPL-1004, ¶124.



APPL-1011, FIG. 2

In comparison to providing a video output without fusion in embodiments of FIGS. 1 and 2, Golan's embodiment of FIG. 6 includes "**fusion module 660**" that performs fusion using images 630 and 632 to provide output image frame 650, which "has the resolution of image sensor 610 ... **and** the color of image sensor 612." APPL-1011, FIG. 6, [0064], [0067]; APPL-1004, ¶125.

Further, Golan discloses providing continuous zoom video mode images. APPL-1004, ¶126. Specifically, Golan describes that zoom control sub-system 10 may perform a "**continuous** zoom process 200" of FIG. 2, and provide a video output with "**continuous electronic zoom capabilities with uninterrupted imaging**" by using "**continuous digital-zoom values**." APPL-1011, FIG. 3, [0040]-[0041], [0051]-[0053]; APPL-1004, ¶126.

Golan also discloses each output image having a respective output resolution. APPL-1004, ¶127. Specifically, as shown in FIG. 2, Golan uses "[s]tep 260: **resampling** the acquired image frame **to the requested zoom**" to generate the output image frame. APPL-1011, [0047]-[0049]; APPL-1004, ¶127. A POSITA would have understood that Golan's resampling process includes upsampling or downsampling to generate the output image, and each output image therefore has a respective resolution. APPL-1004, ¶127.

A POSITA would have been motivated to apply Golan's teachings of providing, without fusion, continuous zoom video mode output images in the design

of the system of Parulski and Christie to obtain the benefits of continuous zoom and reduced discontinuity in the video mode output images, particularly given Christie's express suggestion of the same for video. APPL-1004, ¶128. *See also* VIII.A.5: Reasons to Combine Golan with Parulski and Christie.

Therefore, the combination of Parulski, Christie, and Golan teaches that the camera controller including image processor 50 is configured to, in video mode, provides without fusion continuous zoom video mode output images of the object or scene, each output image having a respective output resolution, which renders obvious the camera controller configured "*to provide without fusion continuous zoom video mode output images of the object or scene, each output image having a respective output resolution*" as recited. APPL-1004, ¶129.

[1.6] ***wherein the video output images are provided with a smooth transition when switching between a lower zoom factor (ZF) value and a higher ZF value or vice versa,***

The combination of Parulski, Christie, and Golan teaches limitation [1.6]. APPL-1004, ¶¶130-139.

First, as discussed at [1.5], in the combination of Parulski, Christie, and Golan, a camera controller is configured to provide video output images. APPL-1004, ¶131.

Second, Parulski discloses switching between Wide sensor and Tele sensor when switching between a lower zoom factor (ZF) value and a higher ZF value for providing video output images. APPL-1004, ¶132. Specifically, relative to FIG. 8

below, Parulski describes "**capturing <u>video</u> images** using the image capture assembly of FIG. 1." APPL-1006, 18:25-27; APPL-1004, ¶132. Parulski explains user input zoom position received at block 101 "is **compared to a value X** at which the image capture function **<u>switches</u>** from the first image capture stage to the second image capture stage." APPL-1006, 15:51-57; APPL-1004, ¶132. A video image at a lower ZF value that is less than or equal to X is "**captured** in block 118 **by the <u>first</u> image capture stage 1**," and a video image at a higher ZF value "greater than X" is "**captured** in block 138 **with the <u>second</u> image capture stage 2**." APPL-1006, 18:29-38; 18:45-53;APPL-1004, ¶132.

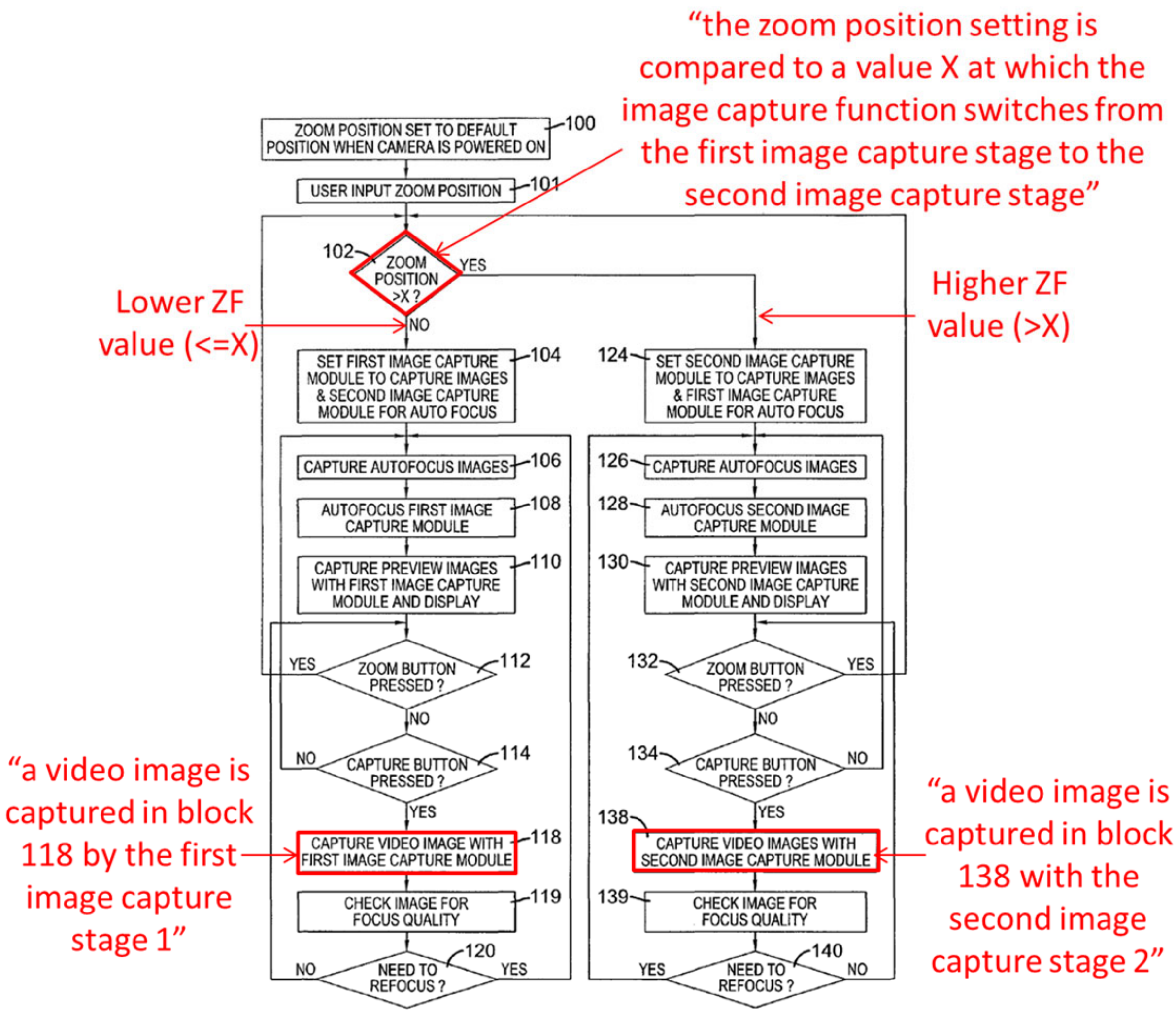


FIG. 8

APPL-1006, FIG. 8, annotated

As discussed at [1.3], Parulski's first image capture stage 1 corresponds to Wide imaging section including Wide sensor, and second image capture stage 2 corresponds to Tele imaging section including Tele sensor. APPL-1004, ¶133. As such, Parulski teaches that video image at a lower ZF value less than or equal to zoom factor X is provided by Wide sensor, and video image at the higher ZF value greater than zoom factor X is provided by Tele sensor. *Id.*

Third, Golan discloses that video output images are provided with smooth transition when switching between wide image sensor 112 (Wide sensor) and tele image sensor 110 (Tele sensor). APPL-1004, ¶¶134-136. Specifically, Golan teaches using a calibration process to "determine the **alignment offsets between wide image sensor array 110 and tele image sensor array 112**" with "sub-pixel accuracy." APPL-1011, [0045]; APPL-1004, ¶134. By using the calibrated, high accuracy alignment offsets between Wide and Tele sensors to provide "**continuous electronic zoom with uninterrupted imaging, when switching back and forth between the wide image sensor array and the tele image sensor array**," jumps (discontinuousness) in video output images when switching between Wide and Tele sensors (and their corresponding point of views) are minimized. APPL-1011, Abstract, [0045]; APPL-1004, ¶¶135-136. As such, Golan discloses providing video output images with a smooth transition when switching between Wide sensor and Tele sensor facilitated by "electronic calibration step [] performed on each pair of adjacently disposed image sensor arrays." APPL-1011, [0045]; APPL-1004, ¶126.

Dr. Cossairt confirms that numerous camera design and image processing methods were well known for providing video output images with a smooth transition when switching between two adjacent sensors. APPL-1004, ¶137; APPL-1015, 14; APPL-1013, FIGS. 2.12, 6.2-6.3, 50-51, 275-278; APPL-1012, 4:12-26.

A POSITA would have been motivated to apply Golan's teachings of a zoom control system with continuous electronic zoom with uninterrupted imaging maintained when switching between adjacently disposed image sensors (e.g., using calibrated alignment offsets between Wide and Tele sensors), in the system of Parulski and Christie, to obtain the benefits of providing, without fusion, video output images with continuous electronic zoom and uninterrupted imaging when switching between Wide and Tele sensors. APPL-1004, ¶138. *See also* VIII.A.5: Reasons to Combine Golan with Parulski and Christie.

In the combination of Parulski, Christie, and Golan, in video mode, the camera controller including image processor 50 is configured to provide, without fusion, video output images with continuous electronic zoom with uninterrupted imaging when switching back and forth between the Wide sensor and Tele sensor, where Wide sensor is used to capture video image at a lower ZF value less than or equal to zoom factor X and Tele sensor is used to capture video image at a higher ZF value greater than zoom factor X. APPL-1004, ¶139. Therefore, Parulski in combination with Christie and Golan renders obvious that "*the video output images are provided with a smooth transition when switching between a lower zoom factor (ZF) value and a higher ZF value or vice versa*" as recited. APPL-1004, ¶139.

[1.7] ***wherein at the lower ZF value the output resolution is determined by the Wide sensor, and wherein at the higher ZF value the output resolution is determined by the Tele sensor.***

The combination of Parulski, Christie, and Golan teaches limitation [1.7]. APPL-1004, ¶¶140-143.

First, as discussed at [1.6], the combination of Parulski, Christie, and Golan teaches that video output images are provided with a smooth transition when switching between a lower zoom factor (ZF) value and a higher ZF value or vice versa, where video image at the lower ZF value (e.g., equal to or lower than zoom factor X) is provided by Wide sensor, and video image at the higher ZF value (e.g., greater than zoom factor X) is provided by Tele sensor. APPL-1004, ¶141.

Second, as discussed above at [1.5], Golan's resampling process generates an output image with a particular resolution from the image frame acquired from either the wide or tele sensor based on requested zoom. APPL-1004, ¶142. A POSITA would have understood that resolution of the acquired image frame is determined by the sensor (e.g., its sensor resolution) that acquires the image frame, and as such, the output resolution of the video output image is determined by the respective sensor and the requested zoom. *Id.*; *see, e.g.*, APPL-1011, [0004]-[0005]; APPL-1006, 23:58-61.

In the combination of Parulski, Christie, and Golan, when switching between Wide and Tele sensors in video mode, at the lower ZF value, Wide image data from Wide sensor is used to provide the corresponding video output image. APPL-1004,

¶143. As such, the resolution of the corresponding video output image at the lower ZF value is determined by the Wide sensor. *Id.* At the higher ZF value, Tele image data from Tele sensor is used to provide the corresponding video output image. *Id.* As such, the resolution of the video output image at the higher ZF is determined by the Tele sensor. *Id.* Therefore, Parulski in combination with Christie and Golan renders obvious "*wherein at the lower ZF value the output resolution is determined by the Wide sensor, and wherein at the higher ZF value the output resolution is determined by the Tele sensor*" as recited in the claim. *Id.*

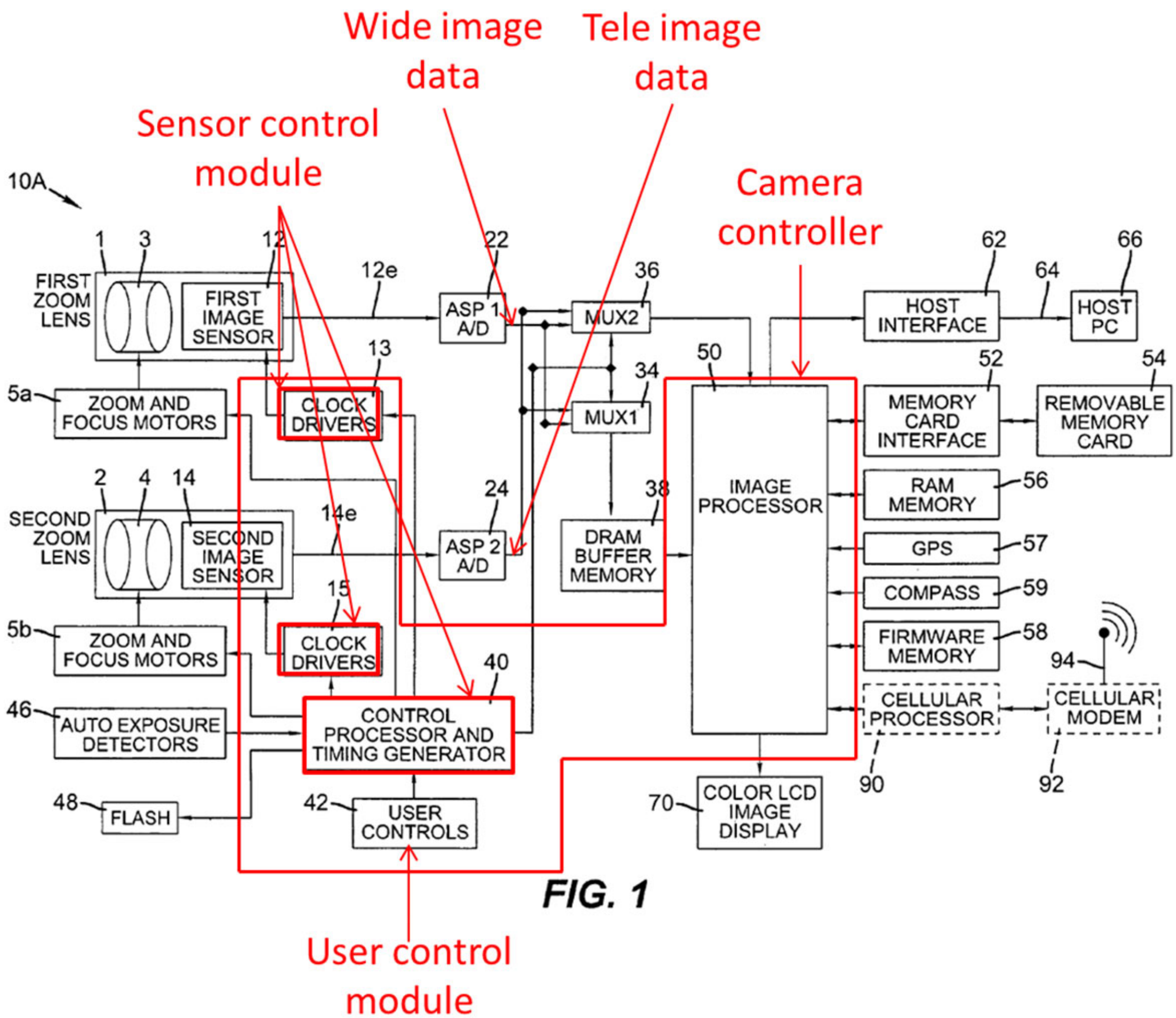
7. Claim 2

[2.0] ***The camera of claim 1, wherein the controller includes a user control module for receiving user inputs and a sensor control module for configuring each sensor to acquire the Wide and Tele image data based on the user inputs.***

The combination of Parulski, Christie, and Golan teaches limitation [2.0]. APPL-1004, ¶¶144-153.

First, as discussed at [1.1] and [1.2], Parulski teaches Wide and Tele sensors for providing Wide and Tele image data respectively. APPL-1004, ¶145.

Second, Parulski teaches a user control module for receiving user inputs including zoom factor. APPL-1004, ¶146. Specifically, as shown in FIG. 1 below, Parulski's "user controls 42 are used to control the operation of the digital camera l0A," which includes, "a zoom button 42c for enabling a selection of a **zoom setting**." APPL-1006, 12:60-64, 13:45-47; APPL-1004, ¶146.



APPL-1006, FIG. 1, annotated

As in FIG. 2B, Parulski discloses that user controls 42 receive a user input zoom factor from zoom button 42c in digital camera 10A. APPL-1006, 12:55-65, 15:51-53, APPL-1004, ¶147. Dr. Cossairt confirms these and other examples (e.g., still/video modes, shutter button for enabling image capture sequence) of user controls in Parulski (see FIG. 2B) and correspondingly in Christie (see FIG. 5N).

APPL-1004, ¶¶147-148; *see also* below annotated APPL-1006, FIGS. 4B and APPL-1007, FIG. 5N (APPL-1008, 5N).

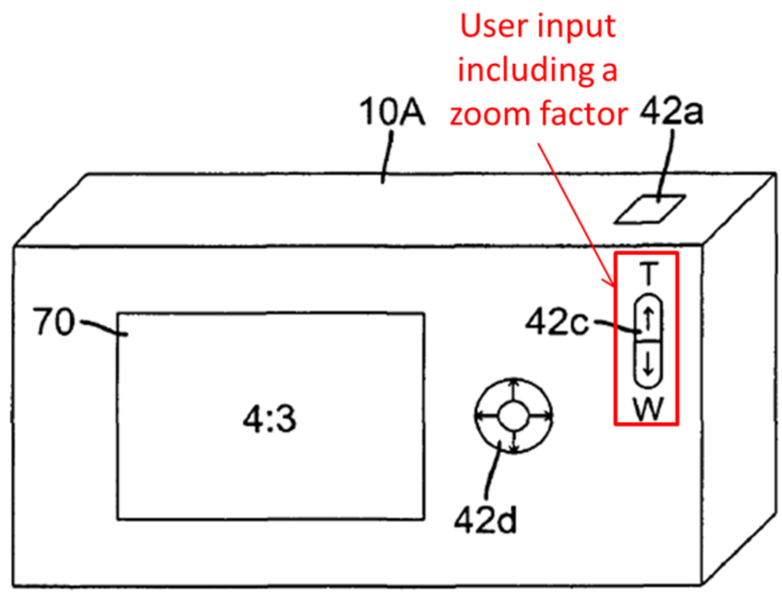


FIG. 2B

APPL-1006, FIG. 2B, annotated

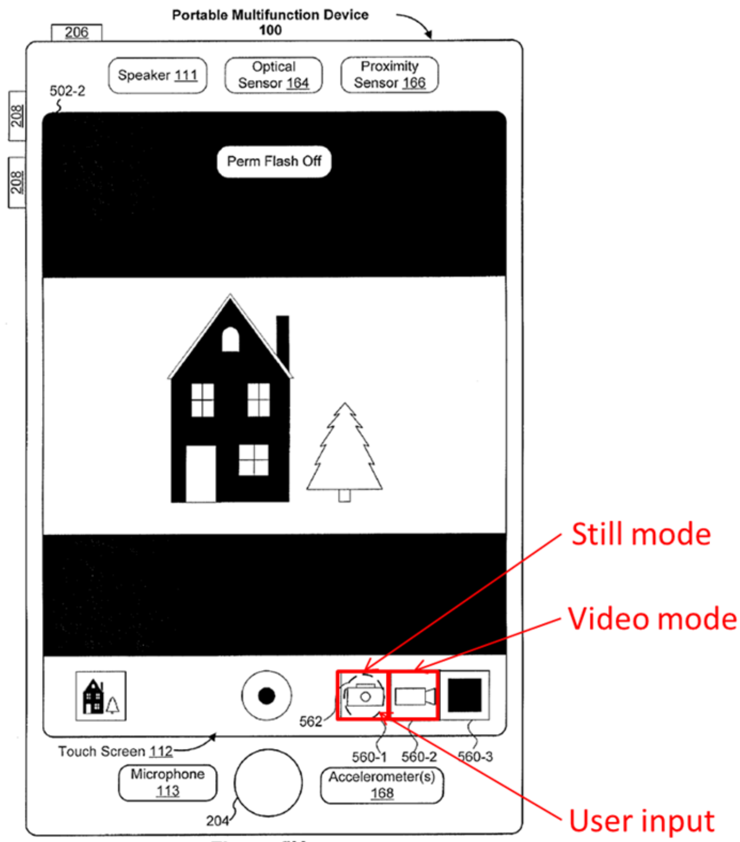
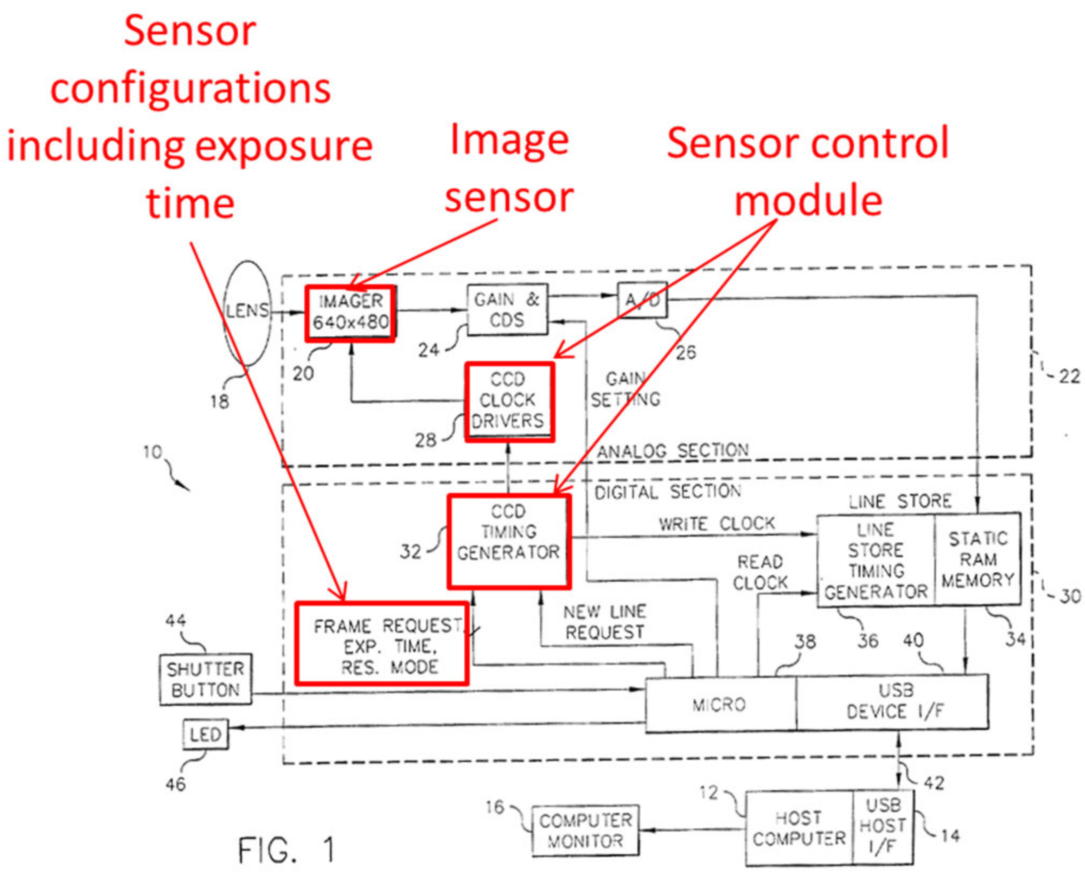


Figure 5N

APPL-1007, FIG. 5N, annotated

Third, Parulski teaches a sensor control module for configuring each sensor to acquire the Wide and Tele image data based on the user inputs. APPL-1004, ¶150. Specifically, as shown in FIG. 1 of Parulski, control processor and timing generator 40 receives user control inputs from user controls 42, and "**controls the first image sensor 12** by supplying signals to clock drivers 13, and **controls the second image sensor 14** by supplying signals to clock drivers 15." APPL-1006, 12:38-41; APPL-1004, ¶150. A POSITA would have understood that it was commonplace to use timing controls (e.g., Parulski's control processor and timing generator 40, together

with clock drivers 13 and 15) to configure sensors (e.g., Wide and Tele sensors) by setting the corresponding exposures for capturing image data. APPL-1004, ¶150; *see also, e.g.*, APPL-1017, FIG. 1, [0022], [0024].



APPL-1017, FIG. 1, annotated

As discussed above at [1.4], Parulski discloses, in still mode, configuring primary capture unit and scene analysis capture unit to provide a primary image and a secondary image (e.g., with different exposures) respectively for generating an augmented primary image (e.g., with extended dynamic range). APPL-1004, ¶151. Parulski further describes that such primary capture unit and scene analysis capture

unit are determined based on user input, specifically, a requested zoom factor from a user. APPL-1006, FIG. 23, 27:8-24; APPL-1004, ¶151. Accordingly, Parulski discloses using control processor and timing generator 40, together with clock drivers 13 and 15, to configure the corresponding Wide and Tele sensors with respective exposures to acquire primary image (one of the Wide and Tele image data) and secondary image (the other of the Wide and Tele image data) having different exposures based on user requested zoom factor and user input camera mode (e.g., still mode). APPL-1006, 29:29-34, 30:1-21; APPL-1004, ¶¶151-152.

The combined teachings of Parulski, Christie, and Golan provides a camera controller that includes user control module 42 for receiving inputs including a user requested zoom factor and a camera still/video mode, and a sensor control module including control processor generator 40 and clock drivers 13 and 14 for configuring, in still mode, the Wide sensor and Tele sensor with different exposures to acquire the Wide image data and Tele image data with respective exposures based on user requested zoom factor and user input camera still mode. APPL-1004, ¶153. Thus, the combination renders obvious that "*the controller includes a user control module for receiving user inputs and a sensor control module for configuring each sensor to acquire the Wide and Tele image data based on the user inputs*" as recited in the claim. *Id.*

8. Claim 3

[3.0] ***The camera of claim 2, wherein the user inputs include a zoom factor, a camera mode and a region of interest (ROI).***

The combination of Parulski, Christie, and Golan (as applied to claim 2) teaches limitation [3.0]. APPL-1004, ¶¶154-158.

First, as discussed at [2.0], the combination of Parulski and Christie discloses that the user control module is configured to receive user inputs including the zoom factor and a camera still/video mode. APPL-1004, ¶155.

Second, Christie teaches that user inputs include region of interest (ROI). APPL-1004, ¶156. As shown in FIGS. 5A and 5B below, Christie teaches that "device 100 displays magnified area (which can also be referred to as an 'autofocus loupe') 522" in response to detecting a tap-and-hold gesture with contact 520 at location 520-a, which "enables a user to **more accurately select an autofocus reference point** in the camera preview." APPL-1007, [0166], [0208]; APPL-1008, [0126], [0168]; APPL-1004, ¶156. As such, Christie teaches a tap-and-hold gesture with contact 520 (user input) indicating a region of interest 520-a (ROI), the center of which is also indicated at point 524-1. APPL-1004, ¶150. It is noted that the '291 Patent provides that "'ROI' is a user defined as a[sic] sub-region of the image" and "is the region on which both sub-cameras are focused on." APPL-1001, 6:25-28; APPL-1004, ¶156.

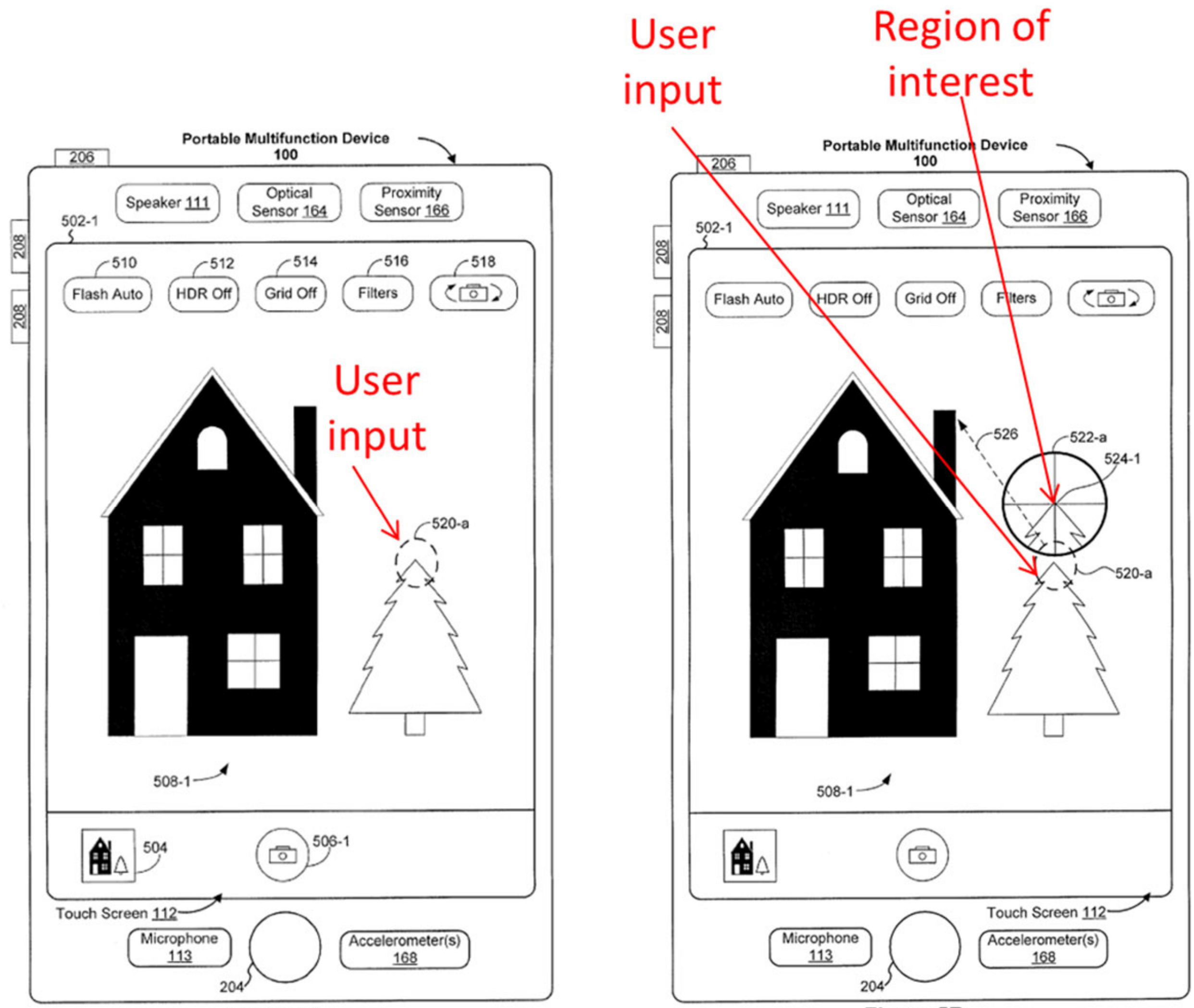


Figure 5A Figure 5B

APPL-1007, FIGS. 5A and 5B, annotated

Like Christie, Parulski teaches "an autofocus system" in a digital camera. APPL-1006, 1:20-23; APPL-1004, ¶157. Parulski already considered a user's need to emphasize one object more than another at different distances, e.g., "to emphasize the dog [sitting in the foreground] more than the beautiful scenery [in the most distant ranges]." APPL-1006, 21:10-13, 27-31; APPL-1004, ¶157. As such, a POSITA would have been motivated to apply Christie's teachings of an

ROI user input in the combination of Parulski, Christie, and Golan, to enable a user to "more accurately select an autofocus reference point." *See* APPL-1007, [0208]; APPL-1008, [0168]; APPL-1004, ¶157. *See also* VIII.A.4: Reasons to Combine Christie with Parulski.

Thus, in the combination of Parulski, Christie, and Golan, a camera phone includes a camera control including a user control module for receiving user inputs including a zoom setting, a camera mode for selecting between still and video modes, and an autofocus reference point, which renders obvious that "*the user inputs include a zoom factor, a camera mode and a region of interest (ROI)*," as recited in the claim. APPL-1004, ¶158.

9. Claim 4

[4.0] ***The camera of claim 2, wherein the sensor control module has a setting that depends on the Wide and Tele fields of view and on a sensor oversampling ratio, the setting used in the configuration of each sensor.***

The combination of Parulski, Christie, and Golan (as applied to claim 2), also teaches limitation [4.0]. APPL-1004, ¶¶159-171.

First, the combination of Parulski, Christie, and Golan discloses a camera controller configured to provide without fusion continuous zoom video mode output images of the object or scene as discussed at [1.5], and discloses a sensor control module of the camera controller for configuring each sensor to acquire the Wide and Tele image data based on the user inputs as discussed at [2.0]. APPL-1004,

¶160.

Second, and more specifically, Golan discloses that in a video mode, a switch setting for switching back and forth between Wide and Tele sensors in digital zoom depends on a sensor oversampling ratio (e.g., with a value of 6.48). APPL-1004, ¶161. Specifically, Golan teaches "continuous electronic zoom with uninterrupted imaging is also **maintained when switching back and forth between adjacently disposed image sensors**." APPL-1011, [0040]; APPL-1004, ¶161. Golan explains that while typically some information is lost in the process of electronic zoom, (APPL-1011, [0003]), **"[t]he ratio between the image sensor resolution and the output resolution <u>dictates the lossless electronic zoom range</u>**." APPL-1011, [0004]; APPL-1004, ¶161. Golan explains that maximal lossless electronic zoom may be computed using a sensor oversampling ratio, and in an example of "a 5 Megapixel, 2592x1944, image sensor array and an output resolution frame of 400x300" in a video stream, "yields **maximal lossless electronic zoom of 6.48: 2592/400=6.48**." APPL-1011, [0004]-[0005]; APPL-1004, ¶162.

Thus, a POSITA would have recognized that Golan's maximal lossless electronic zoom is a sensor oversampling ratio, PL_{Wide}/PL_{video}. APPL-1004, ¶162. PL_{Wide} is an in-line number (2592) of Wide sensor pixels of Wide sensor 112, and PL_{video} (400) is an in-line number of output video format pixels. *Id.* In Golan's

example, based on the 2592/400 sensor oversampling ratio, an electronic zoom (or digital zoom) up to 6.48x can be considered lossless. *Id.*

Accordingly, a POSITA would have understood Golan to teach a switch setting for switching between Wide and Tele sensors at a zoom factor that depends on the maximal lossless electronic zoom (e.g., to be less than the maximal lossless electronic zoom) to obtain "a **large lossless zooming range**." APPL-1011, [0008]; APPL-1004, ¶157. Therefore, the switch setting, e.g., the zoom factor at which switching between Wide and Tele sensors occurs, depends on the sensor oversampling ratio. APPL-1004, ¶163.

Third, Golan teaches that its switch setting depends on the Wide and Tele fields of view. APPL-1004, ¶164. Specifically, Golan explains that "[u]sing two (or more) image sensors, having different fixed FOV, facilitate a light weight electronic zoom with **a large lossless zooming range**." APPL-1011, [0009]; APPL-1004, ¶164. Golan explains that in an example, such a large lossless zooming range has a value of (Wide_FOV/Narrow_FOV)^2, which is provided by "switching between the image sensors" and performing digital zoom to both Wide and Tele images. APPL-1011, [0009]; APPL-1004, ¶164.

A POSITA would have understood that the underlying geometric relationships and as such, would have understood that Golan's informal terminology, "Wide_FOV/Narrow_FOV," corresponds to the relative

magnification ratio of an object "**magnified**" in tele image sensor 110 with respect to wide image sensor 112," thereby representing the ratio Tan(θ_wide)/Tan(θ_tele), where θ_wide and θ_tele are the corresponding semi-angle of view θ such as illustrated in Fig. 4.13 of Jacobson below. APPL-1011, [0037]; APPL-1004, ¶165. Accordingly, a POSITA would have understood that Golan teaches that the switch setting, e.g., the zoom factor at which switching between Wide and Tele sensors occurs, depends on the relative magnification ratio of Tele image to the Wide image, which in turn depends on the Wide and Tele fields of view. APPL-1004, ¶¶165-166.

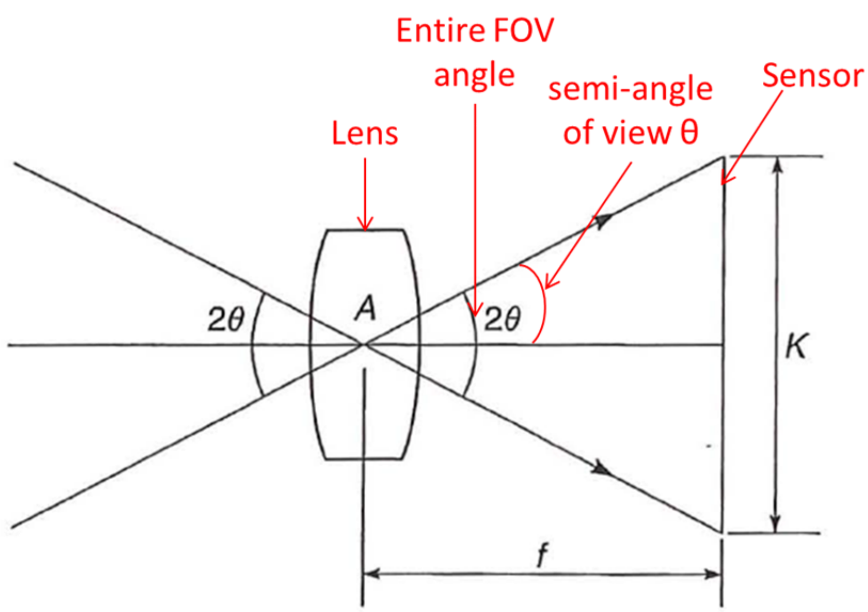
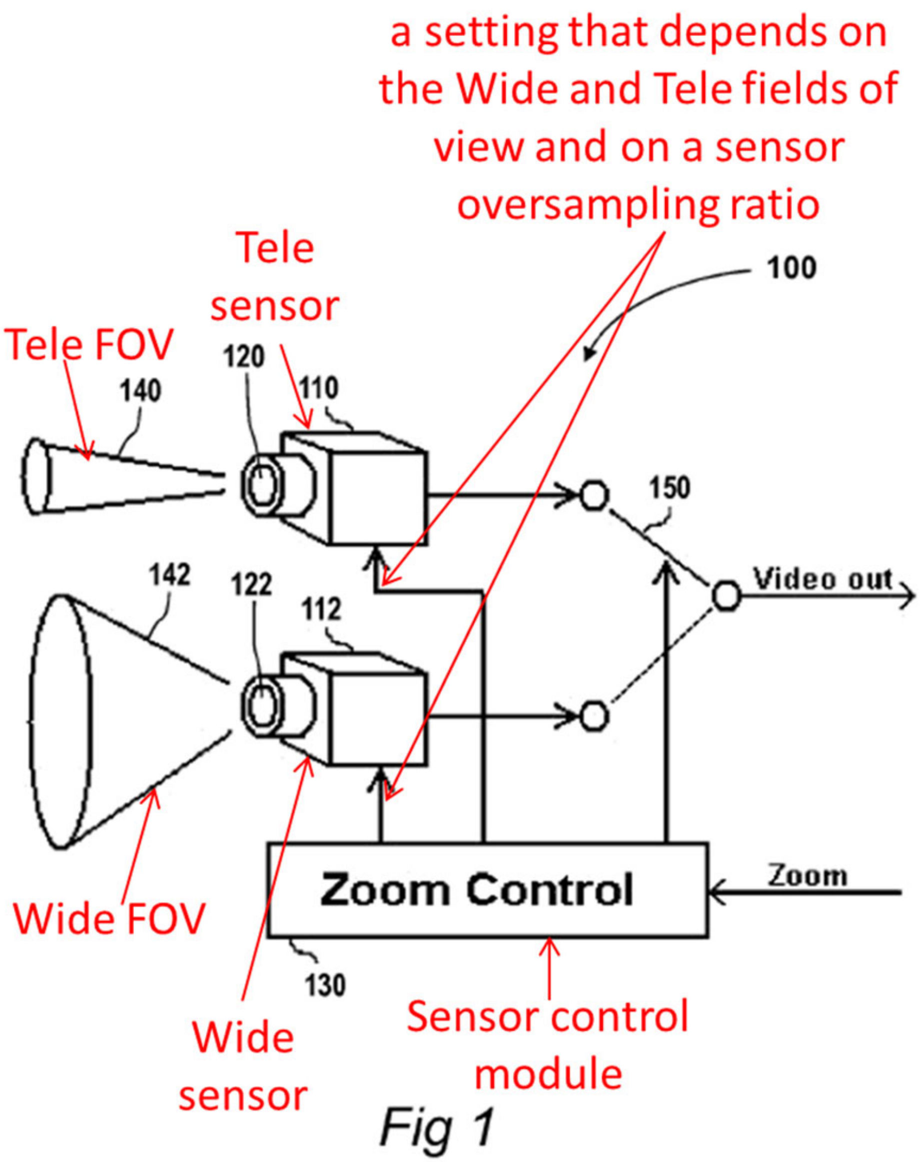


Figure 4.13 Field (angle) of view (FOV) of a lens related to format dimension

APPL-1016, FIG. 4.13, annotated

Golan teaches that the switch setting is used to "select[] the relevant image

sensor." APPL-1004, ¶167. Specifically, as shown in Figure 1 of Golan below, a zoom control 130 (sensor control module) "receives a required zoom from an operator of the image acquisition system, and **selects the relevant image sensor** (110 and 112) by activating image sensor selector 150 position." APPL-1011, [0039]; APPL-1004, ¶167. A POSITA would have understood Golan to teach selecting one image sensor and not the other to be operational in such circumstances. APPL-1004, ¶167.



APPL-1011, FIG. 1, annotated

Fourth, Parulski teaches using a switch setting between two sensors in the configuration of each sensor when no fusion (e.g., for image augmentation) is used, and reinforces Golan's teaching of selecting one image sensor and not the other to be operational. APPL-1004, ¶168. Specifically, Parulski teaches in a "digital camera using multiple lenses and image sensors to provide an improved

zoom range" without providing the image augmentation process, "**<u>only</u> one** of the two image sensors **is used at a time**" and that "[t]he two image sensors do **<u>not</u>** simultaneously capture images." APPL-1006, 5:21-35; APPL-1004, ¶168.

Accordingly, a POSITA would have recognized that Parulski teaches that a switch setting for switching between two sensors is used in the configuration of each sensor when no fusion is used. APPL-1004, ¶169. The selected sensor (e.g., one of the Wide and Tele sensors) is configured to be in an operating mode for capturing the corresponding image data (e.g., Wide or Tele image data), and to conserve power, the other non-selected sensor (e.g., the other of the Wide and Tele sensors) is configured to operate in a non-operating mode (e.g., a stand-by mode or a turned-off mode) such that the non-selected sensor is not used at the same time as the selected sensor and does not simultaneously capture images. APPL-1004, ¶169; *see, e.g.,* APPL-1018, 18-19 ("[t]he standby mode option is implemented to allow the user to **reduce system power consumption during periods that do <u>not</u> require operation of the [CMOS image sensor] KAC-1310**."); *see also* APPL-1019, [0013] ("[d]uring utilization of a certain optical zoom step and related sub-camera, **sensor(s) associated with <u>other</u>** sub-cameras may **<u>optionally be turned off</u> for power-saving purposes**")..

A POSITA would have been motivated to combine the teachings of Golan of a switch setting, e.g., the zoom factor at which switching between Wide and Tele

sensors occurs, depending on the Wide and Tele fields of view and on a sensor oversampling ratio for selecting one image sensor from two sensors to capturing image data in video mode and Parulski's teaching of using a switch setting between two sensors in the configuration of each sensor in the system taught by Parulski, Christie, and Golan, to obtain the benefits of continuous zoom and reduced discontinuity in the video mode output images, a large lossless zoom range, reduced power consumption, and extended battery life. APPL-1004, ¶170. *See also* VIII.A.5: Reasons to Combine Golan with Parulski and Christie.

In the system of Parulski, Christie, and Golan, a camera controller includes a sensor control module having a switch setting for selecting one of the Wide and Tele sensors to be operable for capturing the corresponding Wide/Tele image data. APPL-1004, ¶171. The switch setting includes a switching zoom factor at which switching between Wide and Tele sensors occurs that depends on the Wide and Tele fields of view and on a sensor oversampling ratio, and is used to configure each of the Wide and Tele sensors such that the selected image sensor is in an operating mode while the other non-selected image sensor is in a non-operating mode (e.g., a standby or turned-off mode). *Id.* Therefore, Parulski in combination with Christie and Golan renders obvious that "*the sensor control module has a setting that depends on the Wide and Tele fields of view and on a sensor oversampling ratio, the setting used in the configuration of each sensor*" as recited in the claim. *Id.*

10. Claim 5

[5.0] ***The camera of claim 4, wherein the Wide and Tele FOVs and the sensor oversampling ratio satisfy the condition $0.8*PL_{Wide}/PL_{video}<Tan(FOV_{Wide})/Tan(FOV_{Tele})<1.2*PL_{Wide}/PL_{video}$, wherein PL_{Wide} is an in-line number of Wide sensor pixels and wherein PL_{video} is an in-line number of output video format pixels.***

The combination of Parulski, Christie, and Golan (as applied to claim 4) teaches limitation [5.0]. APPL-1004, ¶¶172-177.

First, as discussed at [4.0], Golan teaches a sensor oversampling ratio PL_{Wide}/PL_{video} having a value of 6.48, where PL_{Wide} is an in-line number (e.g., 2592) of Wide sensor pixels of Wide sensor 112, and PL_{video} (e.g., 400) is an in-line number of output video format pixels, as claimed. APPL-1004, ¶173.

Second, Golan teaches $Tan(FOV_{Wide})/Tan(FOV_{Tele})$ having a value of 6. APPL-1011, [0009]; APPL-1004, ¶174. More specifically, Golan explains that, in the example where "**Wide_FOV=Narrow_FOV * <u>6</u>**," "switching between the image sensors provide a loss less electronic zoom of 6^2=36." APPL-1011, [0009]; APPL-1004, ¶174. As discussed at [4.0], Golan's informal terminology, "Wide_FOV/Narrow_FOV," is used to represent the ratio Tan(θ_wide)/Tan(θ_tele), where θ_wide and θ_tele are the corresponding semi-angle of view θ, accordingly teaches "$Tan(FOV_{Wide})/Tan(FOV_{Tele})$" as claimed. APPL-1004, ¶174.

Accordingly, in Golan, a sensor oversampling ratio PL_{Wide}/PL_{video} has a value of 6.48 and $Tan(FOV_{Wide})/Tan(FOV_{Tele})$ has a value of 6, which satisfy $0.8*PL_{Wide}/PL_{video}<Tan(FOV_{Wide})/Tan(FOV_{Tele})<1.2*PL_{Wide}/PL_{video}$, specifically,

$0.8*6 .48<6<1.2*6.48$.

APPL-1004, ¶175.

A POSITA would have been motivated to combine the teachings of Golan of a relationship between the Wide and Tele fields of view and a sensor oversampling ratio in the system taught by Parulski, Christie, and Golan, to obtain the benefits of a large lossless zooming range. APPL-1004, ¶176.

Therefore, in the combination of Parulski, Christie, and Golan, fixed focal length Wide lens 612, Wide sensor 614, fixed focal length Tele lens 616, and output video format pixels of camera phone 600 are configured such that PL_{Wide}/PL_{video} (e.g., 6.48) and $Tan(FOV_{Wide})/Tan(FOV_{Tele})$ (e.g., 6) satisfies limitation [5.0], which renders obvious that "*the Wide and Tele FOVs and the sensor oversampling ratio satisfy the condition* $0.8*PL_{Wide}/PL_{video}<Tan(FOV_{Wide})/Tan(FOV_{Tele})<1.2*PL_{Wide}/PL_{video}$*, wherein* PL_{Wide} *is an in-line number of Wide sensor pixels and wherein* PL_{video} *is an in-line number of output video format pixels*" as recited in the claim. APPL-1004, ¶177.

11. Claim 10

[10.0] ***The camera of claim 1, wherein the camera controller configuration to provide video output images with a smooth transition when switching between a lower ZF value and a higher ZF value or vice versa includes a configuration that uses information either from the Wide sensor or from the Tele sensor.***

The combination of Parulski, Christie, and Golan teaches limitation [10.0]. APPL-1004, ¶¶178-181.

First, As discussed at [1.6] and [1.7], the combination of Parulski, Christie, and Golan teaches that video output images are provided with a smooth transition when switching between lower and higher ZF values, or vice versa, wherein at lower ZF value the output video image is generated using Wide image data provided by Wide sensor, and wherein at the higher ZF value the output video image is generated using Tele image data provided by Tele sensor. APPL-1004, ¶179.

Second, as discussed at [4.0], Golan teaches selecting one image sensor and not the other to be operational when switching back and forth between adjacently disposed image sensors, and Parulski reinforces this teaching. APPL-1004, ¶180. . Parulski teaches a "digital camera using multiple lenses and image sensors to provide an improved zoom range" without providing the image augmentation process, in which "***<u>only</u>* one** of the two image sensors **is used at a time**" and in which "[t]he two image sensors do ***<u>not</u>*** simultaneously capture images." APPL-

1006, 5:21-35; APPL-1004, ¶180. As such, a POSITA would have recognized that the camera controller configuration to provide video output images with a smooth transition includes a configuration that uses information (Wide or Tele image data) either from Wide sensor or from Tele sensor. APPL-1004, ¶180.

In the combination of Parulski, Christie, and Golan, the camera controller including image processor 50 is configured to provide video output images with continuous electronic zoom with uninterrupted imaging when switching back and forth between the Wide sensor and Tele sensor, which includes a configuration that uses either Wide image data from the Wide sensor or Tele image data from the Tele sensor. APPL-1004, ¶181. Therefore, Parulski in combination with Christie, and Golan renders obvious that "*the camera controller configuration to provide video output images with a smooth transition when switching between a lower ZF value and a higher ZF value or vice versa includes a configuration that uses information either from the Wide sensor or from the Tele sensor*" as recited in the claim. *Id.*

12. Claim 12

[12.0] ***A method for obtaining zoom images of an object or scene in both still and video modes using a digital camera, the method comprising the steps of:***

Parulski teaches limitation [12.0]. APPL-1004, ¶¶182-183.

As discussed at [1.0], Parulski's camera phone 600 provides both still and video images using digital zooming based on user input zoom factor, which teaches

"*obtaining zoom images of an object or scene in both still and video modes using a digital camera*" as recited in the claim. APPL-1004, ¶183.

[12.1] ***a) providing in the digital camera a Wide imaging section having a Wide lens with a Wide field of view (FOV), a Wide sensor and a Wide image signal processor (ISP),***

Parulski teaches this limitation for the reasons discussed at [1.1]. APPL-1004, ¶184.

[12.2] [providing in the digital camera] ***a Tele imaging section having a Tele lens with a Tele FOV that is narrower than the Wide FOV, a Tele sensor and a Tele ISP, and***

Parulski teaches this limitation for the reasons discussed at [1.2]. APPL-1004, ¶185.

[12.3] [providing in the digital camera] ***a camera controller operatively coupled to the Wide and Tele imaging sections; and***

Parulski teaches this limitation for the reasons discussed at [1.3]. APPL-1004, ¶186.

[12.4] ***b) configuring the camera controller to combine in still mode at least some of the Wide and Tele image data to provide a fused output image of the object or scene from a particular point of view, and***

Parulski teaches this limitation for the reasons discussed at [1.4]. APPL-1004, ¶187.

[12.5] [configuring the camera controller] ***to provide without fusion continuous zoom video mode output images of the object or scene, each output image having a respective output resolution,***

Parulski in combination with Christie and Golan renders obvious this limitation for the reasons discussed at [1.5]. APPL-1004, ¶188.

[12.6] ***wherein the video mode output images are provided with a smooth transition when switching between a lower zoom factor (ZF) value and a higher ZF value or vice versa, and***

Parulski in combination with Christie and Golan renders obvious this limitation for the reasons discussed at [1.6]. APPL-1004, ¶189.

[12.7] ***wherein at the lower ZF value the output resolution is determined by the Wide sensor while at the higher ZF value the output resolution is determined by the Tele sensor.***

The combination of Parulski, Christie, and Golan renders obvious this limitation for the reasons discussed at [1.7]. APPL-1004, ¶190.

13. Claim 13

[13.0] ***The method of claim 12, wherein the step of configuring the camera controller to provide without fusion continuous zoom video mode output images of the object or scene includes configuring each sensor with a setting that depends on the Wide and Tele FOVs and on a sensor oversampling ratio.***

The combination of Parulski, Christie, and Golan (as applied to claim 12), also teaches limitation [13.0]. APPL-1004, ¶¶191-193.

First, as discussed at [1.5] and [12.5], Parulski in combination with Christie and Golan discloses configuring a camera controller to provide without fusion continuous zoom video mode output images of the object or scene, each output image having a respective output resolution. APPL-1004, ¶192.

Second, as discussed at [4.0], the combination of Parulski, Christie, and Golan teaches that the step of configuring the camera controller to provide without fusion continuous zoom video mode output images of the object or scene includes

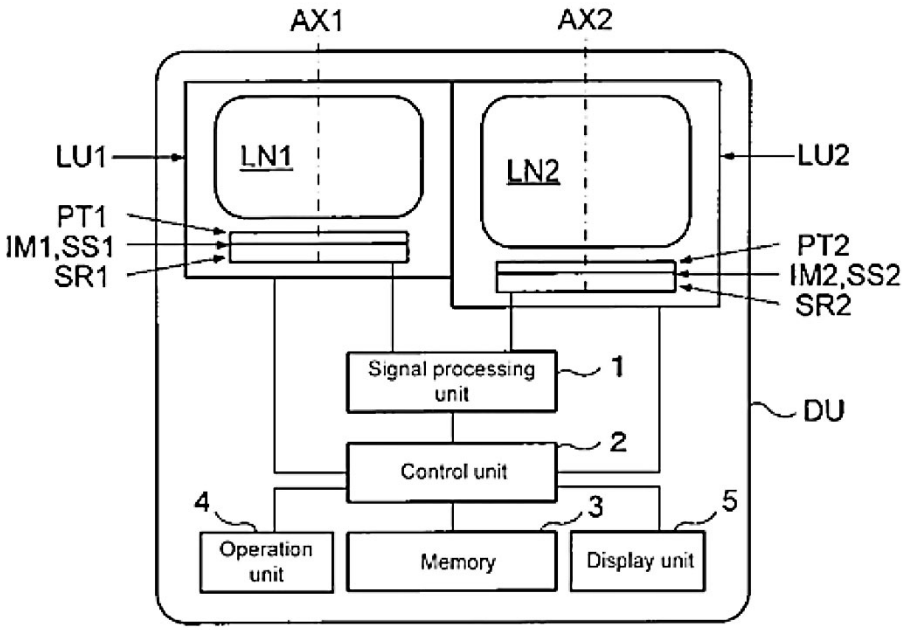
configuring each sensor with a setting that depends on the Wide and Tele FOVs and on a sensor oversampling ratio. APPL-1004, ¶193. Specifically, Golan teaches a switch setting, e.g., a zoom factor at which switching between Wide and Tele sensors occurs, that depends on the Wide and Tele FOVs and on a sensor oversampling ratio. APPL-1011, [0004]-[0005], [0008]; APPL-1004, ¶193. Therefore, Parulski in combination with Christie, and Golan renders obvious that "*the step of configuring the camera controller to provide without fusion continuous zoom video mode output images of the object or scene includes configuring each sensor with a setting that depends on the Wide and Tele FOVs and on a sensor oversampling ratio*" as recited in the claim. APPL-1004, ¶193.

B. Ground 2: Claims 6-7 are unpatentable under §103 over Parulski, Christie, Golan, and Konno

1. Summary of Konno

Like Parulski and Golan, Konno describes digital zooming using images from fixed focal length wide range and telephoto lenses to provide a broad zoom range. APPL-1004, ¶¶194-197. To provide "a high-performance thin and small-sized imaging apparatus" with a broad zoom range, as shown in FIG. 21 below, Konno teaches "[a]n imaging apparatus includes single-focus first and second imaging optical systems LN1 and LN2 that face the same direction" and have different focal lengths. APPL-1015, Solving Means, [0049]; APPL-1004, ¶195.

[FIG. 21]



APPL-1015, FIG. 21

2. Reasons to Combine Konno with Parulski, Christie, and Golan

A POSITA would have been motivated to combine the teachings of Konno with the system(s) taught in combination by Parulski, Christie, and Golan to obtain the benefits of a dual-lens high-performance thin and small-sized imaging apparatus with a wide zoom range at low costs. APPL-1004, ¶¶198-202.

First, the references are analogous prior art and are in the same field of endeavor (digital imaging systems). APPL-1015, Solving Means, [0002], [0049]; APPL-1004, ¶199.

Second, Parulski explicitly suggests the combination. Parulski describes

that its dual-lens zoom digital camera "provides an **improved imaging capability** without unduly increasing the **size or cost**" and may be integrated into a camera phone. APPL-1006, 8:13-16; APPL-1004, ¶200. Konno teaches various optical system designs to obtain a dual-lens "**high-performance thin and small-sized** imaging apparatus capable of acquiring an image of **high quality and high resolution**" that "can be realized at **low costs**" and used in "mobile phones." APPL-1015, [0002], [0006], [0017], [0046]; APPL-1004, ¶200. For example, Konno teaches a telephoto ratio condition (e.g., between 0.7 and 1.0) to achieve balanced performance and size of second imaging optical system LN2, and various lens element configurations (e.g., five lens elements configurations for both wide and tele lenses). APPL-1015, FIGS. 11, 16, [0007], [0040]-[0041]; APPL-1004, ¶200.

Accordingly, in the design of the system of Parulski, Christie, and Golan, a POSITA would have looked to Konno's teachings of imaging optical system designs to obtain a dual-lens high-performance thin and small-sized imaging apparatus with a wide zoom range at low costs. APPL-1004, ¶¶201-202.

3. Claim 6

[6.0] ***The camera of claim 1, wherein the Tele lens includes a ratio of total [track] length (TTL)/effective focal length (EFL) smaller than 1.***[3]

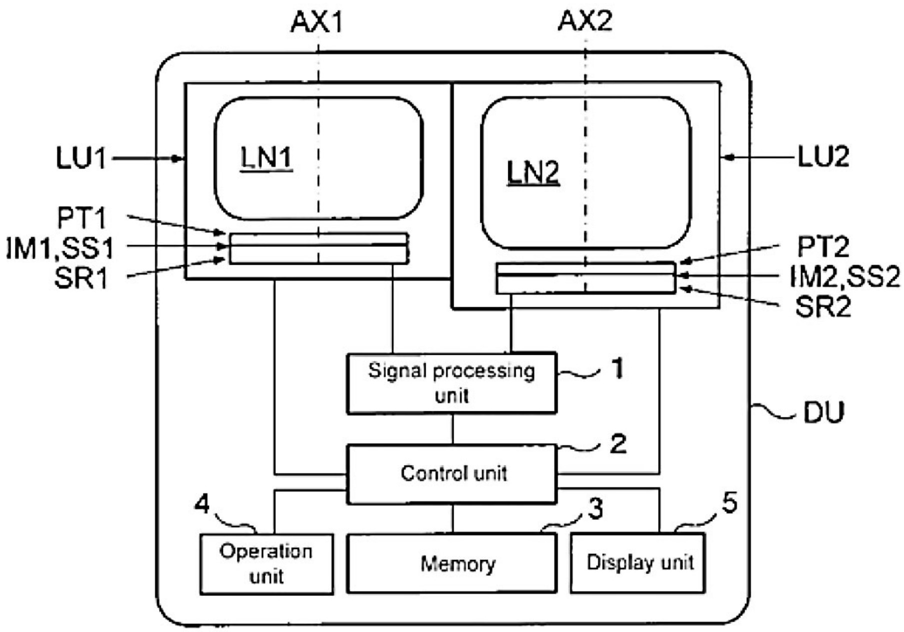
The combination of Parulski, Christie, Golan, and Konno teaches this limitation. APPL-1004, ¶¶203-208.

First, Konno teaches that second imaging optical system LN2 is a fixed focal length Tele lens. APPL-1004, ¶204. As shown in FIG. 21 below, Konno teaches in an imaging apparatus, "focal length fm of the second imaging optical system LN2 **is longer than** the focal length fw of the first imaging optical system LN1." APPL-1015, [0049]; APPL-1004, ¶204. Konno explains that electronic zoom uses LN1 "from **a wide angle end** to an intermediate focal length state," and uses LN2 "from the intermediate focal length state **to a telescopic end**." APPL-1015, [0007]; APPL-1004, ¶204. As such, a POSITA would have understood that

[3] Claim element [6.0] provides "*a ratio of total [sic] length (TTL)....*" APPL-1001, 13:41-43. Omission of "track" in "total length" appears to be an obvious error susceptible to correction. For purposes of this Petition, petitioner assumes that "total track length" is the appropriate correction and has applied the art accordingly.

Konno's LN1 and LN2 teach a fixed focal length Wide lens and a fixed focal length Tele lens respectively. APPL-1004, ¶204.

[FIG. 21]



APPL-1015, FIG. 21

Second, Konno teaches that second imaging optical system LN2 includes a ratio of total track length (TTL)/ effective focal length (EFL) smaller than 1. APPL-1004, ¶205. Conditional expression (6) of Konno is provided as follows:

<u>0.7 < TLm/fm < 1.0,</u>

where TLm is the "[e]ntire lens length (distance from the face nearest to the object side (first face) to the image face) of the second imaging optical system," fm is the "[f]ocal length of the entire second imaging optical system." APPL-1015, [0040]; APPL-1004, ¶205.

A POSITA would have understood that TLm and fm of LN2 correspond to TTL and EFL as claimed respectively. APPL-1004, ¶206; *see also, e.g.*, APPL-1021, 3:24-26; APPL-1020, 2:59-61. As such, Konno's conditional expression (6) teaches that LN2 (Tele lens) includes a ratio of TTL/EFL smaller than 1 as claimed. *Id.*

It would have been obvious for a POSITA to use a fixed focal length Tele lens with TLm/fm less than one, as taught by Konno, in the combination of Parulski, Christie, and Golan, to obtain the benefit of "slim[ming] down the second imaging optical system" "in keeping a good balance with performance." *See* APPL-1015, [0041]; APPL-1004, ¶207. *See also* VIII.B.2: Reasons to Combine Konno with Parulski, Christie, and Golan.

Therefore, in the combination of Parulski, Christie, Golan, and Konno, fixed focal length Tele lens 616 of camera phone 600 has a telephoto ratio (TLm/fm) less than one, which renders obvious that "*the Tele lens includes a ratio of total [track] length (TTL)/effective focal length (EFL) smaller than 1*," as recited in the claim. APPL-1004, ¶208.

4. Claim 7

[7.0] *The camera of claim 6, wherein each lens includes five lens elements.*

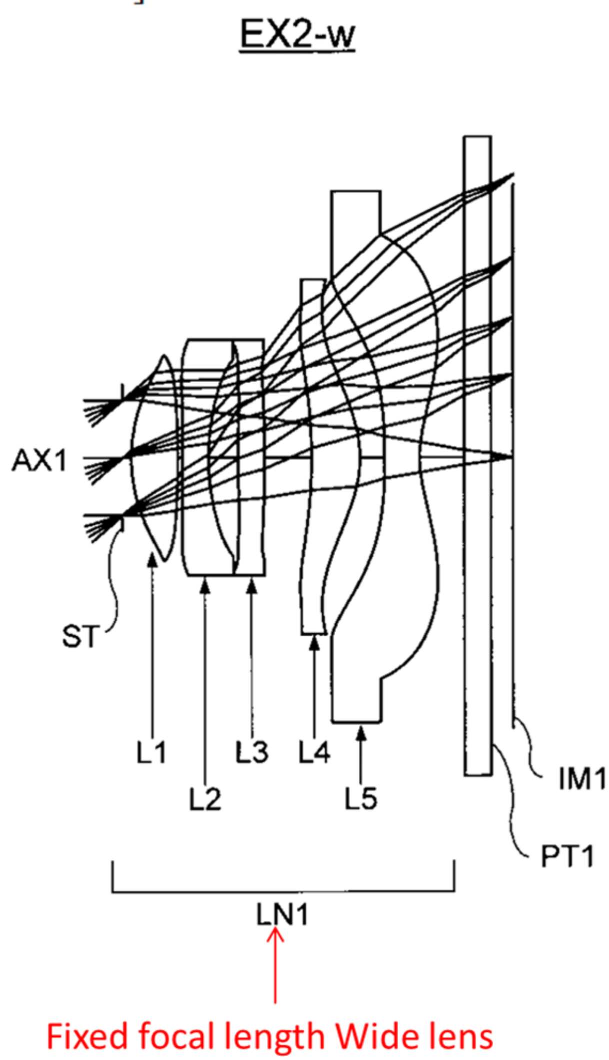
The combination of Parulski, Christie, Golan, and Konno (as applied to claim 6) teaches limitation [7.0]. APPL-1004, ¶¶209-216.

First, as discussed above at [6.0], Konno teaches that first imaging optical system LN1 is a fixed focal length Wide lens, and that second imaging optical system LN2 is a fixed focal length Tele lens. APPL-1004, ¶210.

Second, Konno explains that "Examples 1 and 2 (EX1, 2) are numerical examples corresponding to the first and second embodiments, respectively," (APPL-1015, [0057]), and FIGS. 11 and 16 illustrate LN1 and LN2 in Example 2 (EX2) that are examples of fixed focal length wide and tele lenses in the imaging system of Figure 21 above. APPL-1015, [0055]; APPL-1004, ¶211.

Third, Konno teaches that LN1 includes five lens elements. APPL-1004, ¶212. Specifically, as shown in FIG. 11 below, Konno's LN1 in EX2 includes five lens elements L1, L2, L3, L4, and L5. APPL-1015, FIG. 11, [0056]; APPL-1004, ¶212.

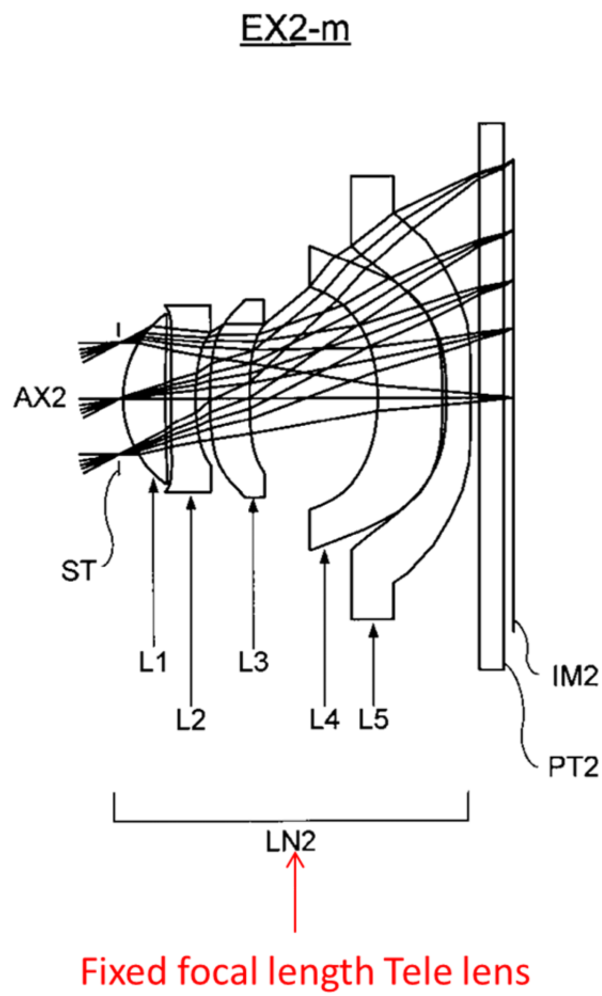
[FIG. 11]



APPL-1015, FIG. 11, annotated

Fourth, Konno teaches that LN2 includes five lens elements. APPL-1004, ¶213. Specifically, as shown in FIG. 16 below, Konno's LN2 in EX2 includes five lens elements L1, L2, L3, L4, and L5. APPL-1015, FIG. 16, [0056]; APPL-1004, ¶213.

[FIG. 16]



APPL-1015, FIG. 16, annotated

It would have been obvious for a POSITA to use five lens elements in each of the fixed focal length Wide lens and fixed focal length Tele lens in the combination of Parulski, Christie, Golan, and Konno, as taught by Konno, to obtain the benefit of "compensating field curvature and chromatic aberration" for the fixed focal length Wide lens, and "a high telephoto property ... advantageous for reducing the entire length" for the fixed focal length Tele lens. APPL-1015,

[0036]; APPL-1004, ¶¶214-215. *See also* VIII.B.2: Reasons to Combine Konno with Parulski, Christie, and Golan.

Therefore, in the combination of Parulski, Christie, Golan, and Konno, each of the fixed focal length Wide lens 612 and fixed focal length Tele lens 616 of camera phone 600 includes five lens elements, which renders obvious that "*each lens includes five lens elements*," as recited in the claim. APPL-1004, ¶216.

IX. CONCLUSION

For the reasons set forth above, Petitioner has established a reasonable likelihood that claims 1-7, 10, and 12-13 of the '291 patent are unpatentable. Petitioner requests institution of an *inter partes* review and cancelation of claims 1-7, 10, and 12-13.

Respectfully submitted,

Dated: July 13, 2018

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X. CERTIFICATE OF WORD COUNT

Pursuant to 37 C.F.R. §42.24, the undersigned attorney for the Petitioner declares that the argument section of this Petition (Sections II–IX) has 13,960 words, according to the word count tool in Microsoft Word™.

/*David W. O'Brien*/
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Lead Counsel for Petitioner
Registration No. 40,107

CERTIFICATE OF SERVICE

The undersigned certifies that, in accordance with 37 C.F.R. § 42.6(e) and 37 C.F.R. § 42.105, service was made on Patent Owner as detailed below.

Date of service	July 13, 2018
Manner of service	USPS Priority Mail Express International®
Documents served	Petition for *Inter Partes* Review of U.S. Patent No. 9,185,291; Certificate of Word Count; Petitioner's Exhibit List; Exhibits APPL-1001–APPL-1022
Persons served	Nathan & Associates Patent Agents Ltd P.O. Box 10178 Tel Aviv 6110101 ISRAEL

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